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[*Photo on Cover :* The Falls, Waterval Boven.

[NOTE.—Articles from *Farming in South Africa* may be published provided acknowledgment of source is given.]

One of the Old School.

IN December last, Mr. Pieter Koch, on reaching the age limit, retired from the service of the Department in which he had served since 1913.

Mr. Koch was born in Middelburg, Transvaal, where he received his early education. After matriculating, he attended the Transvaal University College for six months, proceeding to America to take courses in sub-tropical agriculture at the University College of Missisippi and Alabama. Obtaining his degree with distinction at the latter, he spent another year at the University of Kentucky, and then joined the Federal Government Department of Agriculture in Washington D.C. for six months.

His career as an Agricultural Officer covered a period of 34 years, starting in 1913 in East London where he worked for 3 years; his next post was at the Elsenburg College Agriculture and seven years later he assumed duty at Rustenburg where, for two years, he devoted himself mainly to the improvement of our tobacco industry.

Since 1925 he has been employed in the Head Office at Pretoria as Chief Crop-Production Officer of the Department. His activities have been concentrated principally on tobacco, cotton and fibre plants; he also gave guidance in research work in connection with the other agricultural crops.

On several occasions he was sent to neighbouring states on government missions to investigate the fibre industry. Pieter Koch is a widely travelled man. His travels included extensive journeys through America, where he visited 38 States; he also visited Mexico, Scandinavia and other European countries.

It is learnt with pleasure, however, that the Government intends to avail itself of Mr. Koch's extensive knowledge and experience by retaining his services in an advisory capacity.

FARMING IN SOUTH ... AFRICA

Vol. 23 JANUARY 1948 No. 262

Editorial:

The Year 1948.

Dr. C. H. Neveling, Secretary for Agriculture.

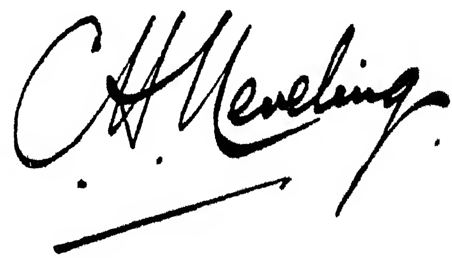
LOOKING back on the events and achievements in the sphere of agriculture for the year 1947 leads to the realization that our agricultural industry is gradually recovering from the setbacks it experienced during the war years as a result of the shortage of the instruments of production such as fertilizers, farm implements, proteins and other necessities. All our difficulties have, of course, not yet been finally surmounted, but a definite improvement is discernible, as is borne out by the following facts: We have produced a maize crop capable of supplying the needs of the country; our potato crop attained dimensions which necessitated the exportation of a portion of it; our groundnut crop was able to bring about a considerable improvement in the supply of vegetable fats; and our wheat crop is expected to be good. The improvements effected in regard to the instruments of production, the reinforcement of the bases of our agricultural policy, and the stabilization of prices enabled us, to a large extent, to wipe out our shortages within a comparatively short space of time.

In addition to the discontinuation of rationing in the case of such a basic food as maize, it was possible also to abolish restrictions in regard to the consumption of butter as from the beginning of December. I hope that 1948 will see the end of other restrictive measures.

We stand on the threshold of the New Year, full of expectations and inspired with a spirit of optimism. Good rains over the larger portion of the summer-rainfall area have strengthened our belief that this year will be favourable. The agricultural industry of the Union possesses astonishing powers of recovery, which in the past have commanded our admiration and are bound to play their usual rôle in the coming year. It is very encouraging to note that the industry is steadily increasing its production and that the agricultural population is showing itself capable of greater achievements each new season.

During 1947 the preliminary work in regard to the application of the Soil Conservation Act was largely completed. Numerous soil-conservation districts were proclaimed and district committees appointed, and conservation schemes are now being elaborated. We are now entering the active stage in which soil conservation, soil fertilization and improvement of our farming systems will come to fruition. The year 1948 will, therefore, usher in a new era in the history of the rehabilitation of farming in South Africa.

Let us remind ourselves that a sustained effort must lead to success.



Short Courses at the Stellenbosch-Elsenburg College of Agriculture.

During 1948 the following short courses will be conducted at the Stellenbosch-Elsenburg College of Agriculture:—

At Elsenburg.		Fee. (*including boarding*). £ s. d.
(1) Dairy and Pig Farming	28 June–2 July, 1948	1 10 0
(2) Viticulture	28 June–2 July, 1948	1 10 0
(3) Poultry Farming	5 July–9 July, 1948	1 10 0
(4) Pomology	5 July–9 July, 1948	1 10 0

**At Stellenbosch.*		*Fee.* £ s. d.
(5) Grain Grading	28 June–9 July, 1948	0 10 0
(6) Domestic Science	27 September–1 October, 1948	0 5 0
(7) Vegetable Growing	29 November–3 December, 1948	0 5 0

*Fees at Stellenbosch are in respect of tuition only. Students should make their own arrangements for boarding.

Drying of Grain in Bags.

G. M. Dreosti and J. D. Louw, Dehydration and Cold Storage Laboratory, Cape Town.

AS a result of research extending over a period of several years, the authors of this article have developed a grain drier capable of drying grain in bags.

The complete description of this study and the technical details of the grain drier itself and of the processes to be followed are contained in a scientific bulletin to be published shortly.

In the meantime the authors have decided to publish a brief description of the grain drier as developed in the laboratory tests, and to outline the requirements for the successful drying of wheat, maize and oats.

Judging from the tests, such a grain drier should without modification be a success if used on a commercial scale for the drying of wheat, maize and oats. There appears to be no reason why it should not be used for the drying of other cereals such as malt and, in fact, any granular material handled in bags.

The accompanying diagram shows the most convenient and effective arrangement of the drying unit.

In a unit without insulation of the inner walls of the tunnel, 40 to 45 feet may be regarded as the practical maximum length. Such a tunnel should be able to support 25 bags at a time.

The three tunnels are built parallel to each other and spaced in such a way that the bags need only be turned over in order to be transferred from the one to the other. With an average drying time of one hour per bag and a cooling time of half an hour, such a battery of tunnels would be able to dry 1,200 bags in 24 hours.

In a commercial grain drier, automatic temperature control will be a necessity with a view to preventing the inside temperature from varying more than 2° F.

The capital outlay can safely be estimated at the figure of £3,000 inclusive of the cost of the necessary control apparatus such as hydrometers, thermometers, etc.

On the basis of a capacity of 1,000 bags per 24 hours, the total operating costs amount to a drying cost of approximately 3d. per bag.

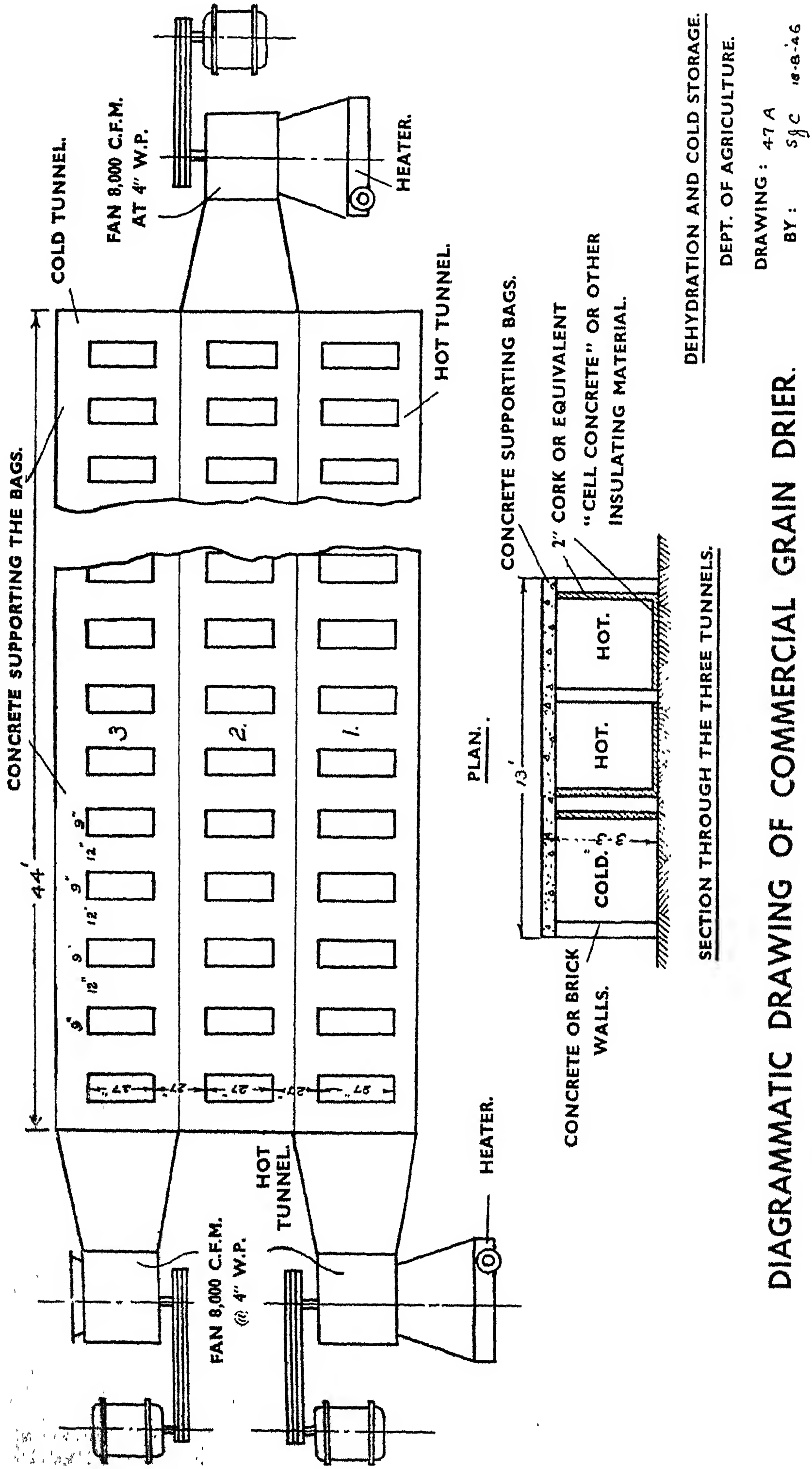
Assuming that the grain drier will be in use for three months every year, during which period a total of 60,000 bags will be handled, and taking an average of 15 per cent. for interest, depreciation and maintenance, the cost of this operation will amount to 1s. 8d. per bag, and the total costs of treating 1 bag approximately 5d.

Allowing 20 per cent. for unforeseen incidentals, it is suggested that a total cost of 6d. per bag may be regarded as a reasonable basis for the calculation of drying costs.

Wheat.

The drying of wheat demands effective control of temperature and air movement, since the baking quality of this cereal is very closely correlated with heat-treatment of the grain.

Initial moisture content plays a decisive rôle in the determination of the drying temperature. The higher the moisture content, the lower the required temperature.



DIAGRAMMATIC DRAWING OF COMMERCIAL GRAIN DRIER.

[Continued on page 32

Margarine.

Dr. C. W. Abbott, Professional Officer, Agricultural Research Institute, Pretoria.

THERE appears to be a great deal of misunderstanding in regard to the desirability of manufacturing margarine in South Africa, and as a result diametrically opposed views are held by certain groups of people. In view of the present situation confronting the dairy industry now that the manufacture of margarine has been legalized in South Africa, and because of the doubts and uncertainty in the minds of many people regarding the raw material, methods of manufacture and food value of margarine, this article is submitted in an attempt to clarify the position.

Dairy farmers and manufacturers are, as a whole, opposed to its production, in which they see a threat to their undertakings. Consumers, as a group, favour its production mainly because of the present shortage and high price of fats of all kinds, including butter. Recently the attitude of butter manufacturers was crystallized in the following statement made in the Chairman's address at the 1947 general meeting of the South African Creameries Association:—

"It is impossible to forsee what injury may be done to the country as a whole, and to agriculture in particular, if the Dairy Industry were compelled to compete with a rival undertaking such as is contemplated in the establishment of margarine factories. . . . I would appeal to those in authority to reconsider the position even at this late hour".

On the other hand, the viewpoint held by many consumers is given in the First Report on the Activities of the National Nutrition Council, published in 1944. In this report special attention is drawn to the widespread incidence of malnutrition in South Africa, and the Council lays emphasis on the fact that it is an unbalanced diet, rather than the lack of sufficient calories in the diet, which occurs most frequently and which is responsible for much of the secondary illness and general inefficiency observed among the lower-income groups, including Europeans, Coloureds and Natives. It would appear that it is especially the fat-soluble vitamin A which is deficient in the diet of many people.

In the ordinary diet the main source of this vitamin is butter, but the report indicates that, even at 1s. 6d. per pound, butter is beyond the purchasing power of the lower-income groups.

One way in which this essential vitamin was made more generally available was by subsidizing the sale of butter through the introduction of the State-Aided Milk and Butter Scheme. This scheme was intended to dispose, within the country, of "surplus" butter, that is to say butter which had previously been exported as it could not be sold within the Union. Subsequently it became very evident that this butter was only "surplus" to the buying power of the people and not to their nutritional needs. With the increase in purchasing power which followed the outbreak of the war, more people were able to purchase butter, so that the ordinary trade channels are now capable of absorbing the total production and there is still not sufficient butter to meet the demand. As the so-called "surplus" of butter has disappeared owing to the higher purchasing power of the people, the State-Aided Scheme now has to compete for its requirements with other consumers. Should more butter be

supplied by means of increased subsidies to the lower-paid groups, less butter would be available to those with higher incomes.

The Council therefore suggested (i) that butter should remain the food of the higher-income groups, (ii) that the production of butterfat should be increased in order that the costs of production and manufacturing may be reduced, and (iii) that the post-war price of the product should be stabilized at about 1s. 6d. per pound for first-grade butter.

These suggestions, however, still left the lower-paid classes without a source, within their means, of vitamin A. The Council thus made the radical proposal that margarine, highly fortified with this vitamin, should be manufactured on a large scale and marketed at a price within the means of the lower-income groups. In spite of strenuous opposition, this proposal finally received legal recognition.

What Margarine is.

Margarine is an edible product made from animal fats or vegetable oils, which are purified, mixed and emulsified in water or milk. Colour, salt and flavouring may be added to it. In countries where no legal restrictions exist, a product can be produced which in appearance, colour, texture, taste and aroma is extremely difficult to distinguish from butter. By the addition of vitamin concentrates it can be given a fixed and constant protective value which may even be superior to that of butter. Like butter, it may not contain more than 16 per cent. moisture. It has often been claimed that margarine, even though properly fortified with vitamins, is still inferior in food value to butter, but up to the present no acceptable scientific proof of this claim has ever been given. Until this proof is forthcoming, the two products may be regarded as being equal in food value.

The Raw Materials.

(I) *Fats.* Various fats and oils of both animal and vegetable origin are used.

A. *Animal fats.*

(1) *Oleo oil* which is obtained from the internal fat of beef carcases, by melting the fat at 155-160°F. immediately after slaughtering.

(2) *Neutral lard* which is obtained by melting pork fat at 120° F.

The fats are washed, ground, melted and purified by settling, after which the oleo oil is separated from the solidified stearin, in a filter press.

(3) *Hardened whale oil* which is prepared by catalytic hydrogenation, followed by deodorizing, so that a product is obtained which at ordinary temperatures is a white odourless solid.

B. *Vegetable oils.*

(1) *Cocoanut oil* which is a solid at ordinary temperatures.

(2) *Palm oil,* which also has a high melting point, is sometimes used to impart a yellow colour to margarine as it is naturally coloured.

(3) *Other vegetable oils,* which are fluid at ordinary temperatures, can be made suitable for use by partial catalytic hydrogenation using the Normann patented process. These include: (*a*) cotton-seed oil, (*b*) groundnut oil, (*c*) soya-bean oil, and (*d*) maize-germ oil.

Only limited quantities of oleo oil and neutral lard are available in this country and, with the advent of factory ships, which accompany the whalers, it is more than likely that less whale oil will be produced at the coastal whaling stations. Of the vegetable oils, only groundnut (peanut or monkey-nut oil) and maize-germ oil are produced in the Union, but not in very great quantities. There is no surplus production of either seeds or oil. It is therefore clear that, while South African animal fats and vegetable oils may be used in the manufacture of margarine, large-scale production will necessarily be dependent on imported raw materials. Alternatively, a greatly increased production of oil-bearing seeds will have to be undertaken in South Africa.

There have been various secondary causes which led to the delay in the production of margarine (such as the loss of equipment by enemy action, and lack of trained staff), but the real cause has been the complete absence, owing to world-wide shortage, of the necessary fats and oils. Consumers are well aware of this shortage, because it is reflected in the general scarcity of butter, cooking fats, soap and candles, and they should therefore understand why there is a shortage of margarine.

II. *Vitamins.* The main purpose in developing a margarine industry is to provide a medium for supplying the malnourished with a cheap source of vitamin A. South Africa is particularly fortunate in this respect, for according to the Nutrition Council's report, the expanding fish-liver-oil industry is able to supply vast quantities of the fat-soluble vitamins at a cost of about 4d. per 1,000,000 units, while the cost of imported concentrates averages about 18s. 6d. per 1,000,000 units.

The claim is frequently made that South Africa is a "land of sunshine" and that vitamin D is therefore of minor importance, as the irradiation by sunlight of body sterols in the skin provides a sufficiency of this vitamin. When it is borne in mind that thousands of natives work in the mines or in stores, shops and factories and on night shifts, the validity of this claim becomes doubtful, and it is therefore desirable that vitamin D should also be included in the diet, especially as a cheap source of this vitamin is readily available. It is necessary to remark in passing that the inclusion of vitamin D in order to be effective requires a properly balanced ratio and quantity of calcium and phosphorus in the diet.

III. *Dairy produce.* It is not generally known that significant amounts of dairy produce are used in the manufacture of margarine. The amount of butterfat ranges from 30 per cent. in a high-grade product down to 1·5 per cent. in the lowest grades. In addition, from 6 to 30 gallons of milk are required for each 100 lb. of margarine manufactured. The flavour and aroma of margarine is obtained from this source.

The Manufacturing Process.

The manufacturing process has been very carefully worked out and at present a remarkably palatable product characterized by excellent keeping qualities can be produced. The whole manufacturing process is carried out according to fixed formulae, and as one is dealing mainly with purified oils and fats of known and fixed melting points, the procedure becomes very largely a mechanical one. Nevertheless, great skill and long experience are required in order to exercise proper control over the various stages of manufacture.

The actual manufacturing processes used are largely trade secrets, but some information can be gleaned from the literature.

The animal fats which are used in the manufacturing process are removed from carcases immediately after slaughtering, washed in ice water to clean and firm them, and then ground. The ground fat is heated to carefully controlled temperatures so that only the desired fractions are liquefied. These are drained off, allowed to settle, and then clarified, and held at temperatures at which they assume a suitable firmness for "churning".

Vegetable oils are expressed by hot or cold pressing, filtered and clarified, hydrogenated to the required degree of "hardness", and then held at suitable temperatures.

Pasteurized milk or cream is soured by means of special bacterial cultures which develop a desirable flavour and aroma typical of good quality fresh butter. The milk or cream is placed in a "churn" and vigorously agitated. The fats, the temperatures of which are carefully controlled, are then run into the churn and the mixture emulsified; after this the emulsion is run into a tank of ice water to crystallize and harden the fat globules formed during emulsification.

The various types of fats have to be blended very carefully to prevent a greasy body and extremely careful control of temperature is necessary throughout the whole process of manufacturing in order to prevent excessive fat crystallization which causes a mealy or granular texture, but details of how this is done and of the final working of margarine into pats are lacking.

A high-grade margarine very similar to butter in taste and appearance can be produced from the following constituents:—

526 lb. oleo oil or hardened vegetable oil,

476 lb. neutral lard,

150lb. butterfat (in form of 50 gallons 30 per cent. cream), and

300 lb. butter.

This will yield about 1,500 lb. of margarine containing 30 per cent. butterfat.

A low-grade margarine of rather unsatisfactory body and texture and with a fatty or oily taste can be made from—

350 lb. oleo oil,

250 lb. cotton-seed oil,

450 lb. lard, and

18 lb. butterfat (in form of 60 gallons 3 per cent. milk).

This will yield just over 1,000 lb. margarine containing about 1.5 per cent. butterfat.

In the modern manufacture of margarine, the substance known as "Natural Product", or "Butter Flavouring", is often used in order to give more flavour to the product. "Natural Product" is largely diacetyl which has an aroma closely resembling that of butter.

Some Economic Considerations.

The Nutrition Council, in its first report, estimated that after the war the price of butter would be stabilized at 1s. 6d. per lb. It did not state whether the creamery interests and the farmers would agree to accept this price, and it is worthy of note that, after more than two years of peace, the price of butter is 2s. 7d. per lb.

It was further stated that it would be possible to retail fortified margarine at a price not exceeding 10d. per lb. without any subsidy, but no indication is given of how this figure was obtained. It should be noted that ordinary hardened vegetable oil containing added vitamins is at present sold at 2s. 9d. per lb. in South Africa, and the price of margarine is announced as being 1s. 4d. per lb., to which must be added the Government subsidy of 3d. per lb., making the actual cost 1s. 7d. per lb.

The present consumption of butter among Europeans is estimated, by the Council, at 29 pounds per year or 1.2 ounces per day. This amount is on the low side for optimum nutrition, so that for purposes of calculation one may take it that a ration of 1.5 ounces per head per day is desirable. This amounts to 35 lb per head per year or a total of 350,000,000 lb per annum for a total population of 10,000,000, including Europeans and Natives, if everyone without exception is to be properly fed. Of this amount the butter industry has never produced more than 65,000,000 lb. and is at present producing not more than 45,000,000 lb. per annum, so that the new margarine industry will have to produce about 300,000,000 lb per year in order to meet the estimated requirements of the population.

For adequate nutrition, therefore, 150,000 tons of margarine containing about 123,000 tons of fat is required each year. One of the main sources of vegetable oil is groundnuts, and the 1946 crop was in the neighbourhood of 18,000 tons. The amount of oil available from this crop could not exceed 7,200 tons. Even if there were 16,000 tons of animal fats and other vegetable oils available after the country's needs of shortening, soap, candles and industrial greases had been met, there would still be a deficiency of almost *100,000 tons* to be met, mainly by import. It is obvious therefore that if butter and margarine are to be supplied to the whole population, it will be very many years before the local production of oils will be sufficient to meet the requirements.

Although the Dairy Industry professes to see in the new industry a threat to its existence, large-scale production of margarine will actually benefit the dairy farmer and butter-manufacturer. There are two reasons for making this sweeping statement, namely:—

(1) Margarine consists largely of vegetable oils. When these are expressed from the seed, the residue is known as oil cake. It is one of the best protein feeds for cattle, and assists in improving their general health and condition, as well as considerably increasing milk production. The demand has always greatly exceeded the supply, but with an increased oil production very much more oil cake will become available. This will go far towards overcoming the protein deficiency which is one of the main causes for the low production of South African cows. By increasing the production per cow, production costs will be lowered and fewer cattle need be kept to produce the same income, thus reducing overgrazing and veld spoilage.

(2) Butter manufacturers in all lands—and those in South Africa are no exception—have always regarded margarine as a competitive product. The South African dairy interests should rather regard it as a supplementary product. According to the present consumption of about 720,000 lb. per week on a 50 per cent. ration, the total requirement of butter is at least 75,000,000 lb. per annum. Only in one exceptionally good year did butter production in South Africa and the neighbouring territories reach 65,000,000 lb. Usually production

fluctuates between 50,000,000 and 60,000,000 lb. There is therefore an average shortfall of about 20,000,000 lb. between the present demand and the production. As there is every indication that the demand will continue to exceed the supply, the margarine industry will help to fill the gap and at the same time provide an additional market for considerable amounts of dairy produce. With the present target of 7,000,000 lb. of margarine per year, about 700,000 lb. of butter and over 500,000 gallons of milk will be absorbed in its manufacture.

Another point which the dairy interests appear to forget is that at no time has the free and unrestricted sale of margarine been envisaged. From the start the intention has been to supply only the lower-income groups with this product, leaving the market open for the supply of butter to the higher-income groups.

Conclusion.

In summing up the position one may state that margarine is a very valuable food, made from animal fats and vegetable oils and containing fixed and known amounts of vitmin A and D.

Its manufacture has been and is still opposed by the dairy interests. These interests do not appear to realize that the national well-being of a people must come before sectional gains. At present there is not enough butter to meet the purchasing power of the nation, let alone its nutritional needs. Even if butter production is expanded to supply the needs of those who can afford it, there will always be a very large group of people whose wages will be so low, in relation to the price of butter, that they could not afford it at any price. The manufacture of margarine is intended to fill the present gap between the production of and the demand for butter, and to supply the nutritional needs of the poorly paid groups in order to improve their health and working capacity.

Actual advantages to dairy producers and manufacturers, which will result from the production of margarine, are a vastly increased supply of oil cake which, if properly fed, will result in a greater production per cow and so lower costs of production. Increased production will also lead to a lower cost of manufacture. Another advantage will be the opening up of a new market for the very considerable amounts of dairy produce used in magarine making. An important point on which the dairy interests have been stangely silent is that the manufacture of margarine is under the control of the Dairy Industry Control Board on which producers and manufactures of dairy produce have an overwhelming majority. The control of margarine manufacture is thus actually and finally in the hands of the dairy interests.

The consumer, too, must take a realistic view of the position. The intention never has been to force down the price of butter; rather it has been to *supplement* existing inadequate supplies of butter. Neither must the consumer expect the impossible. Margarine, like butter, contains more than 80 per cent. of fats. To-day there are simply not enough fats in existence anywhere in the world to allow of very large-scale production, and he must be content with the limited supplies which reach the market.

Anyone who is prepared to see all sides of the picture and ignore sectional interests, can only come to the conclusion that the decision to legalize the manufacture of margarine was one which will prove of general benefit to the country.

Birds of the South African Guano Islands.

R. W. Rand, Biologist, Government Guano Islands.

I. The Banding of Birds.

THE existence of huge flocks of sea-birds on the various islands round our coast presents unique opportunities for ornithological work. A banding project is thus being contemplated which will extend over a number of years and which, it is hoped, will result in many thousands of birds being ringed. Details of the scheme may be of interest to ornithologists engaged on similar work on land or sea-birds in South Africa.

Bird-Banding in other Countries.

Work in America has been summarized by Lincoln (1929). Since then immense strides have been made in this form of ornithological investigation both by amateur and professional ornithologists, as witness the journal '*Birdbanding*'. Banding has been used chiefly in migration studies, but station operators and field workers are tending more and more to use banding technique and data in life-history studies of particular species through a series of individuals.

FIG. 1.—A breeding flock of Malagas or Cape gannets.

McDarra (1941) has put forward a carefully considered plea for properly conducted ringing experiments to elucidate the movements of birds in Australia. His article includes a comprehensive account of the methods and aims of bird-banding, with emphasis on its organization and value to Australia.

In Britain, the British Trust for Ornithology reports the ringing of over 17,000 birds in 1946. Both in Britain and Europe, ringing, especially in connection with migration studies, has been in vogue for many years.

In South Africa, Roberts (1932) has stressed the lack of information about the migratory movements of many African birds, and (1946) has indicated the likelihood of bird-banding on a large scale as the most accurate method of securing data about our migratory birds. The methods to be used and the organization involved are outlined in that publication, which includes a complete list of the South African species concerned. He emphasizes the importance of first learning more about these seasonal migrants before turning to the details of local movements, etc., of resident species.

Bird-Banding Scheme on South African Guano Islands.

Systematic banding on these islands will not, in the immediate future, be confined to migratory species, but attention will be directed mainly to the larger sea-birds of the families *Spheniscidae*, *Sulidae*, and *Phalacrocoracidae*. These are not migratory birds but range for considerable distances round the coast and out into the deep sea.

FIG. 2.—Penguins and nesting burrows in soft sand.

The bands devised are the usual aluminium strips with tongue and eye, enabling the ring to be locked on the bird's foot. Each band carries a serial number following the letters "U.G." Coloured celluloid (open) rings will be used in conjuction with these rings as an aid to further identification. Smaller (closed) rings (number only) will be used for any small birds, e.g. *Motacillidae*, encountered during the work.

A record of the birds banded will be kept at the office of the Union Government Guano Islands in Cape Town. Field returns will be sent in regularly from the islands for registration and analysis.

Aspects of Bird Banding.

Bird-ringing is considered to be one of the most accurate methods of obtaining information about the living bird. The periodic migration of many species which have a breeding and non-breeding range separated by a great distance can only be detected by widespread ringing of the species concerned.

The banding scheme contemplated on the Guano Islands will be concerned primarily with the various phases of the life histories of birds on the islands. With the opportunity to study repeatedly an individual bird, its food habits and breeding behaviour, the progress of plumage colourings and growth, and many other items, the discovery of important facts about the life histories of the guano-producing birds is expected.

Fig. 3.—Nests made of a species of mesembryanthemum on Dyers Island

The most valuable result of banding will be the information it provides about the migratory and other movements of the birds, post-breeding dispersal of adult and immature birds, exchange of populations of different islands, normal range of a species and the possible extension of this range with food and other fluctuations, specialized feeding habits involving dispersal over varying distances, etc.

The analysis of banding data will indicate the general trend of bird activity and will form the basis for long-term control or conservation policies.

II. The Commonest Guano-Producing Birds.

(a) The Black-Footed Penguin *(Spheniscus demersus.)*

One of the most remarkable sights to those landing on many of the islands round our coast is the great number of penguins scattered about the islands, singly or in large flocks or colonies. These are the so-called black-footed penguins (*Spheniscus demersus*), more appropriately called the jackass penguins (on account of their peculiar braying noises), which are important producers of guano needed by South African farmers as a super-fertilizer for vegetable and other crops. These birds are also valued for their eggs, and spesial protective measures are enforced to enable them to breed unmolested.

FIG. 4.—A flock of penguins about to take to the water.

The penguins of Dassen Island are now largely egg-producers and the numbers of eggs gathered during the past few years are as follows:—

1940 : 213,850	1943 : 174,912
1941 : 247,364	1944 : 160,504
1942 : nil	1945 : nil
1946 : 134,592	

On this island the sandy nature of the soil results in much of the guano being lost. On other islands, however, the rocky substrate enables the guano to be scraped from the rock and collected when the breeding season is completed.

The South African penguin is confined to the islands off the coast where it breeds in considerable numbers throughout the year. Stray birds are occasionally found as far north as Durban but the majority are confined to the cold waters of the western Cape Province and South-West African coast.

Breeding Behaviour.

The breeding season appears to extend throughout the year, although few eggs are laid during the summer months of December, January and February, when many adult birds can be seen undergoing their annual moult.

The normal clutch consists of two to three eggs, but the number of chicks fledged seldom exceeds two. The period of incubation varies from four to six weeks. Clutch-size varies considerably under abnormal conditions and in collecting eggs for distribution to the public advantage is taken of the female bird's ability to maintain the normal clutch-size. In the Australian yellow-eyed penguin, however, no attempt is made to lay another clutch of eggs after the female has lost the first.

FIG. 5.—Adults and fledgling Malagas.

Nesting habits vary considerably on different islands. On Dassen Island, where the substrate is loose sand, the nest is invariably situated in a burrow which varies from a shallow depression to a deep sloping tunnel. On the rocky islands, however, nests occur among the pebbles and rocks and may or may not be lined with sticks or seaweed. On Dyers Island a species of *mesembryanthemum* is extensively used as nesting material and the thickly-padded nests serve to keep the breeding birds off the wet ground during the rainy season. Solitary-nesting birds are frequently seen, but the majority occupy large flats or breeding colonies. This social breeding habit facilitates the collection of guano and affords a large measure of protection to the juvenile birds.

The helpless chicks are fed daily, usually by a different parent each day, and grow rapidly till they are able to leave the nest in four or five months' time. Semi-digested fish is disgorged by the

adult birds and the chicks feed by inserting the head far down the parent's throat. This clumsy method of feeding often results in much food dropping onto the ground and being lost.

The chicks lose their natal down within a few weeks and this is replaced by a dull grey juvenile plumage which is lost only after the young birds have left the nests. The first nuptial plumage is almost identical with the normal black and white adult plumage. The post-nuptial moult in the adult birds is a long process, usually lasting about six weeks; bedraggled birds in various stages of this moult can be seen from November to February. The birds abstain from food and refrain from any unnecessary movement during this period and can generally be found standing about the flats.

Courtship and post-nuptial display are difficult to interpret owing to the great similarity between sexes. Nest relief ceremonies, mutual epigamic displaying and the peculair ecstatic attitude resulting in braying, are all seen at various times among the colonies.

A general migration from the nest to the sea occurs at the completion of the breeding season and the flats are then quite deserted of both young and old birds. The birds appear to go out to the deep sea where they remain for some weeks building up a layer of fat to tide them over the moulting period.

(b) The Malagas *(Morus capensis.)*

The established breeding places of these large guano-producing birds occur on all the larger islands round the South African coast. The islands are frequented by these birds for nearly nine months of the year, during which time mating and all the activities associated with the breeding season are completed. After this period the parent birds, together with their fully-grown chicks, are ready to leave the land for their seasonal return to the sea.

The Cape gannet is confined to the South African Guano Islands during the breeding season (summer), but its range is considerably extended during the winter months when the adult and juvenile birds have left the islands. It seems probable that the birds extend northwards as far as the Cape Verde Islands on the west and towards Zanzibar on the east coast. The birds range many miles into the deep sea off our coast, but apparently do not reach the far-off Islands of Tristan da Cunha or the other sub-antarctic islands.

The great flocks of gannets seen on the islands are generally to be found on open areas (flats) which admit of unobstructed landing and taking-off by the birds and which also afford a suitable place for the construction of the nests. Large boulders are generally avoided, but the nesting area may be littered with pebbles.

Generally these are removed to facilitate the collection of guano and the older flats are comparatively clean and smooth.

The colonial-nesting proclivities of the birds result in an aggregate of closely packed nests with little or no room between them. In spite of the proximity of the incubating birds few fights are seen, although bickering and threatening often results when a neighbour accidently encroaches on another's territory. Such squabbles generally end as abruptly as they began. A considerable amount of protection is gained by this system of nesting; apart from the stimulation afforded by the other individuals of the colony and the

synchronization of major activities such as incubation, feeding and rearing of the chicks, the juvenile birds are able to profit by the protection accorded by nearby adults and the rate of mortality is lower than in an equal number of isolated nests. Marauding gulls would not dare to interfere with the nests in a colony but would have little hesitation in pilfering from isolated nests.

The clutch-size is almost invariably one egg. Very occasionally, however, two eggs may be seen in a nest. The single white egg is incubated in a small depression formed by a deposit of mud and dirt stamped and moulded into a saucer-like nest. Additions of nesting-material continue for a long time, the parent birds being seemingly never satisfied with their own nest. The mode of incuba-

FIG. 6.—Adult and juvenile Malagas birds. Note the different plumage stages.

tion is singular: the single egg is covered by the large webbed feet and no incubation spot is developed. The period of incubation is generally about six weeks and young chicks are seen in the nest about the end of September. Both parents take their turn at the nest and incubation becomes a mutual affair.

When first hatched, the nestling is quite naked, but a white downy plumage grows rapidly and soon covers the black body. This white down persists for some weeks till it is replaced by the speckled-grey immature plumage. The chick grows rapidly and gradually reaches the same size as its parents. Both parents assist in feeding the chick which is continually soliciting them for food. Fish caught far out at sea form the staple diet; these are brought back to the nest and disgorged in a semi-digested state when required by the nestling.

The excrement of the young chicks forms the main part of the guano crop. Guano (or liquid excrement) deposited in a haphazard manner upon the nest, dries to form a thick layer over the original cup-shaped nest. No nest-sanitation is practised among these birds,

but the guano seems to cause no discomfort to adult or chick. The nest gradually increases in size with the accumulation of guano till it stands some six inches above the ground. At the end of the breeding season this layer of guano, a dull grey-white material with a faint ammoniacal smell when damp, is scraped off the original nest and broken up before being packed in bags for transport to the mainland.

The social relationships of colonies of breeding gannets are imperfectly understood. The daily activities of the breeding birds seem to take place in three functional areas, namely, the breeding colony area where activities are concentrated on the nest site, a loitering ground, and the distant areas out at sea which are usually the feeding grounds.

Various ceremonials are observed among the adult birds, all of which have some significance in the daily life of the individuals. Thus, before taking to the wing, noticeable preparations are made. This ' flying up ' ceremony is an elaborate way of making known the birds' intention of flying off, thus minimizing the possibility of attack by vicious neighbours. ' Billing ' is another ceremony which is generally seen when a bird returns to its mate; heads are stretched up with the beaks pointing skywards. The necks are then waggled, and the signs of affection are demonstrated. These and other ceremonies seem to preserve a desirable emotional tone between mated birds and so to preserve the bond between partners. Solo displays include the bowing ceremony often observed among solitary birds. During this display the neck is arched and the head brought downwards along the flank to give the appearance of oft-repeated bows. All these ceremonies are especially important among the colonial-nesting birds where mated individuals could easily find other birds at the requisite phase of their breeding cycle if they felt inclined to desert their partners.

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New Bulletins.

The undermentioned Bulletins have recently been published:—

Bulletin No. 248. Duck Farming, Price 6d.

These Bulletins are obtained from the Editor of Publications, Department of Agriculture, Pretoria.

The Avocado in the Western Cape Province.

Daneel du Preez, Western Province Fruit Research Station, Stellenbosch.

IT might seem strange to associate the avocado with the western Cape Province, which is generally regarded as being pre-eminently suited to the growing of deciduous fruits. It should be borne in mind, however, that the western Cape with its diversified climate also offers good possibilities for certain types of subtropical fruits. In the past, limited numbers of avocados, mostly seedlings, have been grown in some areas with a varying measure of success. As seedlings take from seven to eleven years to come into bearing and generally show great variations in yields, they were never really of any commercial importance.

FIG. 1.—Fuerte tree, 18 feet high.

As far as can be gathered, the first orchard of budded trees was planted in 1930 by Mr. C. van der Merwe of Waterval, Blaauvlei, Wellington. The varieties planted were the following: Fuerte, Collinson, Ward and Gottfried. Later Mayapan and Itzamna were added. To-day there are about 150 trees in the orchard and they are looked upon as a good source of income. In subsequent years further commercial plantings were made at Wynberg and Clanwilliam by the Hon. Justice H. S. van Zyl, and also by Dr. Nortier at Clanwilliam.

Variety trial at Groot Drakenstein.

As it was felt that there were distinct possibilities for commercial avocado culture in the milder parts of the western Cape Province, the Western Province Fruit Research Station, Stellenbosch, decided to investigate the matter further. As a result a small-scale variety trial wes started in 1940 on Bien Donne, the

experimental farm of the Institute, in Groot Drakenstein. The initial planting consisted of four trees each of Collinson, Nabal, Itzamna, Fuerte and Puebla, and two trees each of Ward, Linda, Gottfried and Mayapan. The trees were planted in October 1940, and are thus now seven years old. During 1941 some other varieties were also planted, but only those mentioned above will be dealt with in this article.

The orchard soil consists of a deep, light, fertile loam which is well drained. The trees are planted 40 ft. by 40 ft. apart and are irrigated every two or three weeks during summer. The orchard is well protected against the south-easter, but not against the north-western winds.

Fig. 2.—May pan tree, 18 feet high.

With a few exceptions the trees have grown very well since planting. One each of the Collinson and Nabal trees died. One Fuerte and two Pueblas are dwarfed trees and can be regarded as being useless. The reason why these trees have remained stunted, has not been established, but it is most likely a stock effect.

The trees have all along been carefully watched, and certain records have been taken from them. Indications given by them have been noted and the preliminary recommendations given here are based on those indications.

During August and September, 1942, one Puebla and one Fuerte tree started flowering and each tree bore a few fruits during 1943. During the same year the Fuerte, Puebla, Ward, Gottfried, Mayapan and Linda trees flowered and, with the exception of Gottfried, every one again bore a few fruits. The subsequent crop records of the trees are given in Table I.

TABLE I.—*Avocado crops.*

Planted 1940. Variety.	Tree No.	1944. Number of fruits.	1945. Number of fruits.	1946 Number of fruits.	1947. Number of fruits.
Fuerte	1	12	139	180	456
	2	23	171	342	394
	3	45	279	249	566
Puebla	1	0	9	5	46
	2	1	12	8	288
Gottfried	1	0	5	0	8
	2	0	6	0	11
Linda	1	5	0	2	4*
	2	5	7	3	132*
Mayapan	1	33	8	3	45*
	2	20	55	17	92*
Ward	1	7	218	6	539
	2	9	136	8	350
Itzamna	1	0	0	10	108*
	2	0	0	0	32*
	3	0	0	0	77*
	4	0	0	0	89*
Nabal	1	0	0	0	37*
	2	0	0	0	27*
	3	0	0	15	138*
Collinson	1	0	5	5	82*
	2	0	2	8	66*
	3	0	0	0	0*

* Fruit still unripe and counted on the trees.

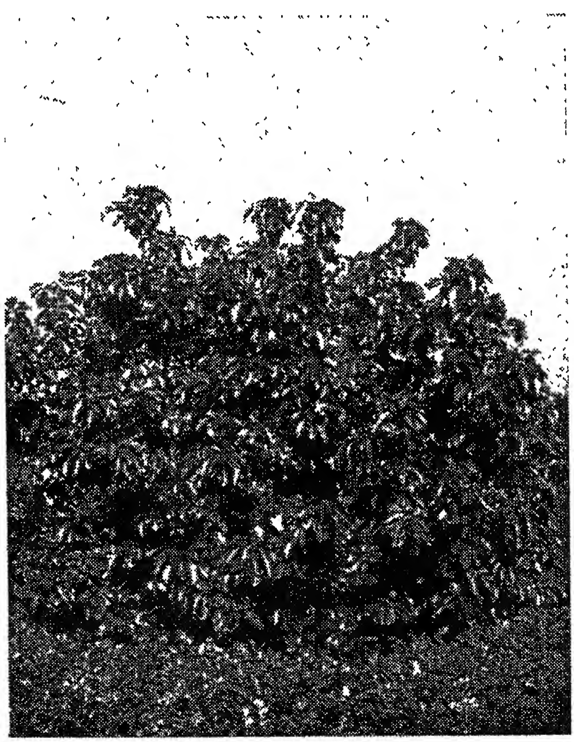

FIG. 3.—Ward tree, 12 feet 7 inches high.

The following tentative deductions can be made from Table I: From 1944 to 1947 the Fuerte trees have borne very well and regularly, and proved to be the outstanding variety (fig. 1). The performances of Puebla, Gottfried and Linda are disappointing and these varieties can rather be ruled out for this area. Puebla is very often a weak and abnormal grower, and Gottfried and Linda shy bearers. Mayapan (fig. 2) and Ward (fig. 3) have borne good crops, but both show signs of alternate bearing. The Itzamna (fig. 4), Nabal (fig. 5) and Collinson trees only started to bear during 1947, and thus no opinion about their possibilities can be expressed. The Itzamna and Nabal trees, however, have developed much better and are larger than the Collinson trees (fig. 6). The latter ripens more or less at the same time as Fuerte, and, since the fruit is of poorer quality, the variety should be discarded.

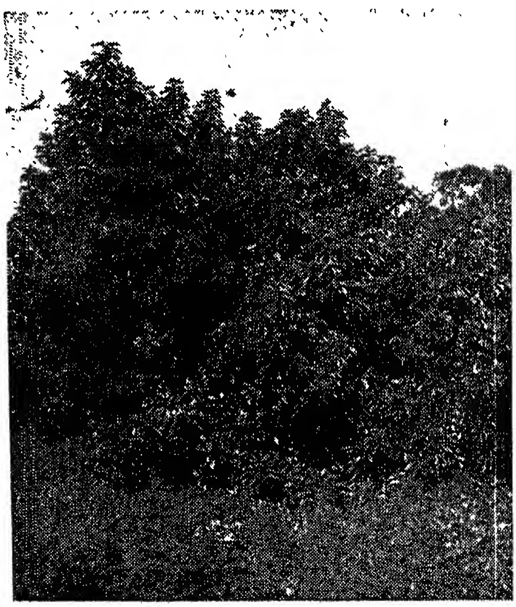

FIG. 4.—Itzamna tree, 19 feet 6 inches high.

Only varieties which ripen from August to December should be planted commercially in the western Cape Province. From August the supply of Natal and Transvaal avocados declines and prices tend to rise. In Table II the months are tabulated during which avocados were picked at Bien Donne.

TABLE II.—*Picking time.*

Varieties.	1943.	1944.	1945.	1946.	1947.
Puebla............	—	—	May–June	June	May–June
Fuerta............	Sept.	Sept.–Oct.	Aug.–Oct.	Aug.–Oct.	Aug.–Oct.
Ward............	—	April–May	—	May–July	May–June
Mayapan.........	—	Oct.–Nov.	Sept.–Nov.	Oct.–Nov.	—
Linda............	—	Oct.–Nov.	Oct.–Nov.	—	—
Gottfried.........	—	—	March–April	—	March–April
Collinson.........	—	—	July–Sept.	June–Aug.	—
Nabal............	—	—	—	Sept.–Nov.	—
Itzamna..........	—	—	—	Dec.–Jan.	—

It is quite clear from Table II that of the most important varieties only Fuerte, Mayapan, Nabal and Itzamna ripen from August to December, and that the choice for planting should be from amongst these. The inclusion of Ward is, however, also recommended in order to have an early avocado, especially for domestic purposes.

At the moment it is deemed advisable to plant the following varieties: 80 per cent. Fuerte and the rest consisting of Ward, Mayapan, Nabal and Itzamna.

Cultural Practices.

It is very important that the young tree, as received from the nurseryman, should be carefully treated. By that time new shoots have very often already developed and thus the roots should be

FIG. 5.—Nabal tree, 21 feet high.

disturbed as little as possible during transplanting. The planting hole should be well prepared beforehand. Immediately after planting, the tree should be watered and also protected against direct sunlight as it is liable to be scorched. To do the latter effectively, different methods may be applied. A protective framework consisting of three parts, as shown in figures 7 and 8, proved to be very effective. If the tree is not well protected against the sun's rays during the first year, it very often happens that the future main limbs and the stem are severely damaged by sunburn.

The following practical hints are again stressed to prevent any disappointment. Plant avocados only on well selected deep fertile soil in which the water table will not rise too high. If the water table is too high, the tree will show signs of "decline" after a few years.

Severe frost will kill young trees; thus areas in which this can be expected, should not be selected. Generally speaking, it can be

FIG. 6.—Collinson tree, 20 feet high.

taken for granted that the abovementioned avocado varieties can be grown successfully under climatic conditions suited to the culture of citrus trees.

FIG. 7.—The three components of the framework.

There are possibilities for avocado production in the warm low-lying areas of the western Cape Province and south-western districts, where the climatic and soil conditions are suitable.

After the trees have been planted, protect them well from scorching until they are able to protect themselves.

During the dry summer months, the trees should be irrigated with water which is free from any alkali salts. The trees are sensitive to alkali salts and thus the quality of the irrigation water should be duly considered.

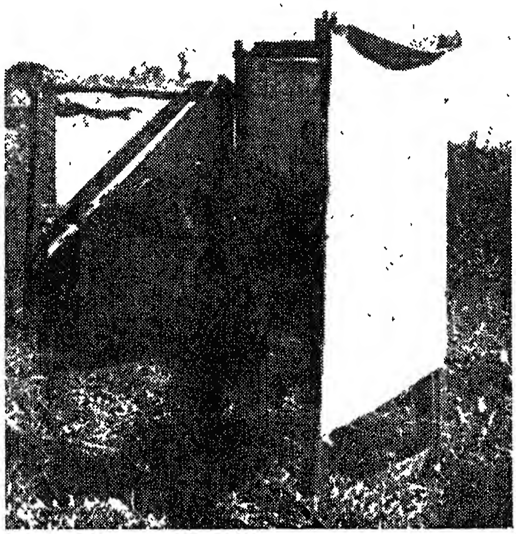

FIG. 8.—The framework placed around the tree.

Plant the trees at least 35 ft. by 35 ft. apart, but preferably 40 ft. by 40 ft.

Thus far pests and diseases have proved to be of no significance, and no control measures have been practised. A disease which has lately been noticed, is bacterial blackspot, and the bacterium *Phytomona syringae* has been isolated from it.* Fortunately it has been found that the varieties which have been recommended are not very susceptible to the disease.

As the culture of the avocado in the western Cape Province is a new branch of horticulture, it will be wise to feel our way carefully and prevent making mistakes previously made.

* Isolated by Miss. C. S. Macfarlane, Plant Pathologist of this Institution.

Nursery Quarantines.

The following nurseries were in quarantine as at 1 December 1947:—

Mooi-uitsig Nursery, Private Bag, Nelspruit, on citrus (all) for red scale.

Fusicladium of Apples.

IV.—Can this Disease be stamped out?

Dr. A. J. Louw, Western Province Fruit Research Station.

TO the scientist the idea of completely stamping out a disease is always attractive. When it comes to agricultural diseases, however, a scheme directed towards this end is often not popular with the farmer, who is impatient of the restrictions and obligations which it imposes, while the State, as a rule, is reluctant to embark on schemes involving expenditure of State funds. Nevertheless, there are instances where undertakings of this nature have been successfully carried out. So for example, citrus canker has been successfully stamped out in the Union.

In recent years, an interesting attempt has been made in Australia to stamp out Fusicladium. Although the disease has occurred in that country for many years, it was only in 1930 that it was first observed in Western Australia, and steps were immediately taken by the State to stamp out the disease by the compulsory application of the following measures:—

(*a*) Dipping in Bordeaux mixture of all nursery trees from other parts of Australia, and complete destruction of consignments in which infected trees were found.

(*b*) The destruction of all infected fruit on farms on which the disease occurred.

(*c*) An autumn spraying of all infected trees and the surrounding soil.

(*d*) The cultivation of a fast-growing cover crop immediately after the crop has been gathered, to obviate the blowing about of infected leaves.

(*e*) The ploughing in of the cover crop as well as the old leaves early in spring.

(*f*) A spraying programme during the growing season.

As a result of this drastic action, no further signs of the disease were observed on some of the farms on which the first outbreaks occurred, up to 1939, i.e. for a period of nine years. Yet outbreaks did occur on other farms. It is, however, suspected that the disease must have been present on such farms in earlier days, but not noticed and hope of the eventual eradication of Fusicladium there has, therefore, not yet been abandoned. It is estimated that if the disease could be completely stamped out in Western Australia, apple growers would be saved a total amount of £20,000 annually, and even if this object is not fully achieved, the measures as applied there may considerably restrict any further spreading of the disease. It is, therefore, mainly with this end in view that the value of eradication measures for application in South Africa has been investigated.

Ploughing in of old Leaves.

Since the infected leaves of the previous season constitute the annual source of Fusicladium infection, it is not to be wondered at that the destruction of the fallen leaves has for a long time been held to be a control measure for this disease. Some advocate the ploughing of the orchards as soon as all the leaves have fallen; others again, do not believe in ploughing in the leaves before spring, by which time the cover crop can be ploughed in as well. In the latter case there is the danger of many of the leaves being blown away

before any cover crop is growing in the orchard. The value of sowing a fast-growing cover crop early in autumn in order to restrict the movement of the leaves is, therefore, patent. Be that as it may, it is evident that the ploughing in of leaves as a control measure for Fusicladium must take place before the trees start budding.

If the huge amount of winter spores that can be formed in a single apple leaf is borne in mind, it will be appreciated that the ploughing in of leaves can never afford absolute control of Fusicladium. A few isolated leaves remaining on the ground can be a potential source of epidemic conditions. The leaves usually drop over a considerable period and they may be blown into furrows, beneath hedges or to similar places where ploughing cannot be carried out. No matter, therefore, how carefully the ploughing is done, there will always remain enough leaves to transmit the disease from one season to another. Experiments have also proved that, if leaves in which the winter phase of Fusicladium has already developed, are buried in the ground and dug up later in the year, the spores of the fungus are by no means always destroyed. It was found that such leaves were capable of spreading the disease even after a number of months. This means that, with the ordinary system of orchard cultivation by which the buried leaves are continually brought to the surface, such leaves may still act as a source of infection.

Yet the ploughing in of the leaves may reduce the source of infection to such an extent as to have a marked influence on the seriousness of the disease, and considerably facilitate control by means of spraying. An experiment carried out in the Ceres district during the 1943-44 season gives us some idea of the relative value of this measure in the control of Fusicladium. A block of apple trees which had been uniformly infected with Fusicladium in the previous season was divided into two parts. The leaves of the one half were very thoroughly ploughed in during winter, and those lying beneath the trees were dug in with spades. Some of the trees in both sections were also sprayed with lime sulphur during the growing season, while others were left unsprayed. The results of the experiment are given in the following table:—

The influence of the ploughing in of fallen leaves with and without the application of summer sprays, on the incidence of Fusicladium in an apple orchard in Ceres during the 1943-44 *season.*

Treatment.	Number of Fusicladium spots per 1,000 leaves on :—			Percentage of Fusicladium-infected fruit at harvesting time.
	28/9/43.	8/10/43.	30/10/43.	
Ploughed but not sprayed.............	97	336	617	95·2
Neither ploughed nor sprayed.............	565	1,221	1,917	99·0
Ploughed and four summer sprays..........	0	0	7	2·9
Not ploughed and four summer sprays.......	0	0	28	7·3

From these data it is evident that the leaf infection early in the season was considerably decreased by the ploughing in of old leaves. In spite of the ploughing in of old leaves the disease never-

theless gained such a hold on the trees that had not been sprayed that at harvesting time there was little difference in the percentage of fruit infected as between the ploughed and unploughed parts of the orchard. The ploughing-in of leaves cannot, therefore, be exclusively relied upon as a control measure for Fusicladium.

Spraying of old Leaves on the Ground.

There are various objections to this method of ploughing-in. During winter and spring the orchards are usually so wet that ploughing operations are precluded until late in October or even November when the foliation of the trees is already well advanced and large-scale infection has set in. Moreover, in recent years, grave objections have been raised against the desirability of ploughing as an orchard practice, and to-day there are apple orchards in the Western Cape Province where ploughing is no longer practised. These objections and the fact that with repeated cultivation some of the buried leaves are again brought to the surface, gave rise to the idea that spraying of the leaves, or the so-called ground spraying, might furnish a solution to the problem.

However, the spraying of the leaves on the ground did not prove as promising as had at first seemed likely. It will be remembered that the winter spores of the Fusicladium fungus are formed in fruit bodies in the old leaves; in other words, the spores of the fungus are actually beyond the reach of a spray which covers only the surface of the leaf. Hence, the usual fungicidal sprays, such as lime sulphur and Bordeaux mixture, have been proved to have no effect on the overwintering stage of the fungus when applied to fallen apple leaves. A spray capable of penetrating the leaf tissue and killing spores (already formed) inside the leaf, had to be found for this purpose. Certain organic chemical substances are well suited to this purpose and Elgetol and Dinitro-orthocresol are two sprays which gave promising results in this respect. Yet in practice, even with ground spraying, all the leaves are never eliminated as a source of infection since many leaves are not covered by the spray. Moreover, the cost of the material required for such a ground spraying is at present too high to permit the general application of this method in the control of Fusicladium. However, these possibilities are being further investigated.

Autumn Sprays.

The proper application of the ground spraying method is greatly complicated where the leaves form a thick carpet on the ground, but this problem can be solved by spraying the leaves in autumn while they are still on the tree. Not only can the leaves be more adequately sprayed in this manner, but less spray is also required. While the leaves are still on the tree the Fusicladium fungus remains on the surface of the leaf and is not yet enveloped in the leaf tissue. At this stage the fungus can to a certain extent still be reached by direct spraying, while with ground spraying the spray must first penetrate the leaf to reach the fungus. It is for this reason that autumn spraying with ordinary fungicides, such as Bordeaux mixture and lime sulphur is sometimes applied with so much success against Fusicladium.

A case is known of a grower who sprayed his apple trees during summer with Bordeaux mixture at winter concentration. As a result all the leaves were scorched and the trees also dropped their

fruit, but the outcome of this operation was that the grower concerned was freed from the nuisance of Fusicladium for several years afterwards. The effect of this drastic spraying measure on Fusicladium is identical with that of leaf scorching with the lead arsenate spray mentioned in a previous article in this series. The leaf tissue in which the fungus exists is killed and consequently the fungus itself also dies, and is therefore unable to form the over-wintering stage and thereby make provision for its recurrence the following season. It goes without saying, however, that this damage to the leaves is detrimental to the tree, and it cannot be recommended as a sound horticultural practice.

After tests had been conducted with a large number of sprays, it appeared that certain spraying mixtures do offer possibilities for the stamping out of Fusicladium in autumn. Under specific climatic conditions the fungus can be effectively killed without serious damage to the leaves, by autumn spraying with lime sulphur and certain copper-lime-arsenic and zinc-lime-arsenic compounds. The prevailing temperature and moisture conditions following the application of the sprays, however, have a dominant influence on the effect of the spraying operations. When a lime-sulphur mixture is used, exceptionally high temperatures may cause the leaves to be damaged to an undesirable extent. Applications of this mixture at a concentration of 1½ and 2 per cent. destroyed the fungus effectively without excessive damage to the leaves. In other instances, however, lime sulphur of the same concentration definitely caused an undesirable degree of leaf-scorching.

The results with Bordeaux mixture were less satisfactory and when applied at concentrations sufficiently high to destroy the fungus, this mixture caused excessive leaf-scorching.

At present the copper-lime-arsenic compounds still appear to be the most promising sprays for autumn application. These compounds tend to cause excessive leaf-scorching under damp weather conditions but this can be very effectively neutralised by increasing the quantity of lime in the mixture. Besides, in the winter-rainfall area weather conditions are dry in autumn so that the application of these compounds will probably be accompanied by a comparably smaller risk. These mixtures have, however, not yet been sufficiently tested to be recommended for general application.

Conclusion.

The practical experience of growers as well as experimental work, has unequivocally pointed out the potential value of some measures for stamping out Fusicladium. These measures, however, are not always in harmony with sound orchard practices.

Some of the sprays most suited to this purpose are too expensive and the use of ground and autumn sprays cannot as yet be recommended for general application.

Nevertheless, some of the measures can be recommended at this stage for application in the following cases:—

(*a*) Where Fusicladium appears for the first time, especially if the outbreak occurs only in an isolated spot in the orchard, thus giving a fair chance of complete eradication.

(*b*) In seasons following on severe Fusicladium epidemics in which the overwintering conditions are conducive to the formation of a serious source of infection on the old leaves.

In such cases the following measures may be advantageously applied:—

(1) Spraying with lime-sulphur mixture (1 gallon to 50 gallons of water) immediately after the fruit has been harvested.
(2) Sowing of a fast-growing cover crop, e.g. barley, as early as possible in autumn.
(3) Ploughing in of the cover crop and the old leaves after the latter have fallen from the trees and definitely before the trees start budding. After this operation no cultivation should be undertaken until the leaves are completely decomposed; in any case not until after the winter and spring rains.

Finally, it must be emphasized that these measures can only be supplementary to the regular summer sprays and must on no account be substituted for the latter.

Summer spraying measures will be dealt with in a subsequent article.

Drying of Grain in Bags:—

[*Continued from page* 6.

It must, however, be pointed out that a moisture content of 19 per cent. is exceptional and must be regarded as apparently the maximum at which wheat can be harvested, especially when use is made of combines.

In a grain drier constructed as described in the above-mentioned bulletin, an air temperature of 150° F. is well within the limits of safety. It would appear that an air temperature of 170° F. or even higher is also safe, judging from the baking tests conducted at this institution.

If drying is done at the temperatures necessary for good baking quality, the drying process does not adversely affect the germination of the wheat.

The results seem to indicate that artificial drying of wheat results in a smaller loss of bushel weight than is the case in sundrying.

The grain drier was constructed on a basis of an average initial moisture content of about 15·5 per cent. during the season and a final moisture content 12·5 per cent., and on the assumption that the air temperature will be maintained at 150· F. The higher the drying temperature, the more rapid the drying of the grain: e.g. at drying temperatures of 110° F., 130° F., 150° F. and 180° F. the respective drying times will be about 140 minutes, 95 minutes, 60 minutes and 45 minutes.

Maize.

Although maize is not as sensitive to heat treatment as wheat, it is nevertheless regarded as advisable to maintain the same maximum drying temperature, especially with a view to avoiding possible damage to the grain's viability.

Oats.

It would seem that oats can be successfully dried at the same temperature as wheat, without suffering any ill effects as regards viability or bushel weight. It also appears that mouldy oats recover their quality under heat treatment.

The Australorp Breed of Fowls.

Prof. A. M. Gericke, Agricultural Research Institute, Pretoria.

THE Australorp or Australian Orpington (Austral-Orp.) was bred in Australia from the Black Orpington. By selection the Orpington was bred from a loose-feathered × a tight-feathered bird and these modified Orpingtons soon became popular as remarkable egg producers. Australorps were imported into this country by a few breeders and from 1925 they were bred on an extensive scale in the Union. To-day the Black Australorp is one of the most popular dual purpose breeds in Southern Africa.

FIG. 1.—Black Australorp cock of good type, bred at the Glen College of Agriculture. His dam laid 326 A-grade eggs in 365 days at the Central Egg-laying Competition.

The Black Australorp and the Black Orpington differ in two essential respects:—

(1) The excessive fluff and loose feathering of the Exhibition Orpington have been eliminated, and consequently the Australorp shows greater length of leg and apparently less bulk of the body owing to the closer feathering.

(2) The Australorp is definitely a better egg producer than the Orpington.

The Australorp and Orpington are so closely related that it is necessary to give a short description of the origin of the latter.

Origin of the Orpington.

The Orpington originated largely from the Black Langshan (an Asiatic breed). William Cook who lived at Orpington, Kent,

bred the first Orpingtons in 1886 and named them after his home town " Orpington ". He bred the Orpington by crossing a large-bodied Black Minorca cock with black sports from Barred Plymouth Rocks and the pullets from this cross were mated to clean-legged Black Langshan cockerels. By further selection he bred single-comb Black Orpingtons which were much shorter in their legs than the Langshan.

According to William Cook, Buff Orpingtons originated from Golden Spangled Hamburgs mated to coloured Dorking hens. The pullets from this cross were mated to Buff Cochin cocks. Certain breeders again claim that the Buff Orpingtons originated from the Lincolnshire Buff, a long-legged bird. The Lincolnshire Buff was bred from a cross between the Buff Cochin and Dorking.

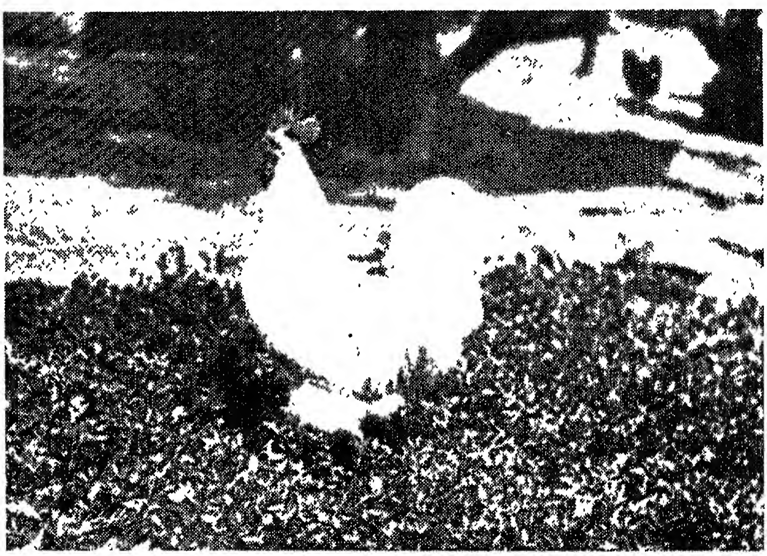

Fig. 2.—White Australorp cockerel.

The White Orpington was produced by crossing White Leghorn cocks to Black Hamburg hens and crossing their progeny with rose-comb White Dorking cocks. The single-comb White Orpington was bred by mating the rose-comb White Orpington to the single-comb White Dorking.

In his book " Fowls for the Times ", published on 17 August, 1896, William Cook made the following remarks regarding the preservation of the Orpington. " A thing of beauty is a joy for ever, and with regard to Orpingtons, I may fairly claim that the birds of these noble breeds are indeed beautiful. The Black, the White and the Buff all full of vitality and consequently resplendent, with full glossy plumage; the good birds of the breed are worthy of a long existence and have come to stay ".

Black and White Orpingtons have been replaced by Black and White Australorps in the Union. The attractive Buff Orpingtons are more popular than the black and white varieties and they are still exhibited at various shows in this country. Buff Orpingtons of good quality were exhibited at the annual show of the Cape Town and Peninsula Poultry Club in June 1947.

The hope expressed by William Cook that the Orpington is worthy of a long existence may come true because the modified Orpington (Australorp) meets the present-day demands of the fancier and the commercial poultry farmer. Most farmers like the Australorp hen, because she is a good egg producer, docile and contented.

A. The Black Australorp.

The general characteristics of this variety are briefly as follows:— The birds have bright red combs and wattles, together with a compact body and black plumage with a beetle-green sheen which gives them a very attractive appearance. The under-colour is from dark grey to black. The beak is short and stout and the colour is black or dark horn. The face is bright red and of bold appearance, not sunken, and free from excessive feathering and wrinkles. The eyes are black, or black with a brown iris, and should be prominent and expressive, free from drooping lids, not sunken or beetle-browed.

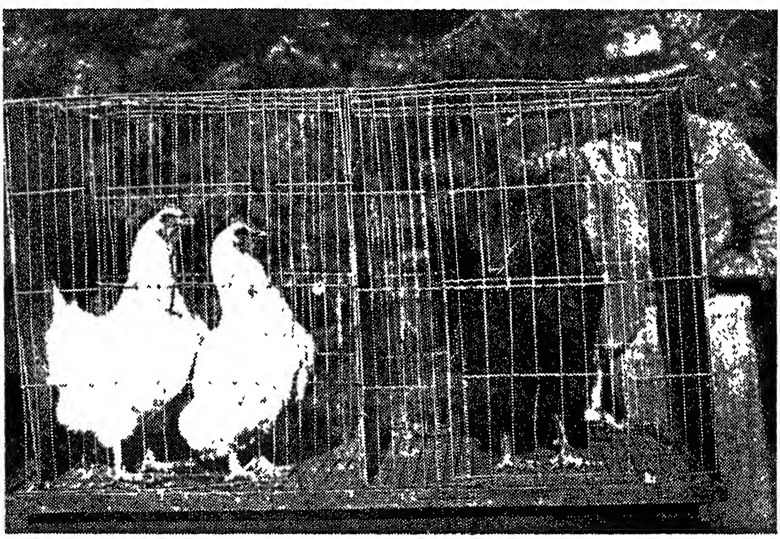

FIG. 3.—Original hens mated to a pure-bred Australorp cock. Good type White Australorp hens.

In both males and females the neck is well arched and of medium length, with a well developed hackle. The back should be as broad and flat as possible, with no indication of roundness. The chest is described as full, well rounded and carried well forward, thus eliminating the tendency of a straight line from the neck to the thighs. The breast bone should be long and straight, the rear point being as nearly as possible in line with the pelvics, not curving upwards towards the stern. In females the pelvic bones should be straight and fine, well set apart and pliable, with no indication of coarseness. The legs and feet are black, shading to slate blue in old birds, of medium length and bone well set apart. The skin of the body as well as the soles of the feet is white.

The live-weights for the breed are as follows:— Cock from 8 to 9 lb., hen from 6 to 7 lb., cockerel minimum 6½ lb., and pullet minimum 4½ lb. In both cocks and hens ½ lb. above or below the

standard weight is allowed. The maximum weight of cockerels and pullets must not exceed the weight of cocks and hens, that is, 8 to 9 lb. for the male and 6 to 7 lb. for the female.

The following scale of points has been adopted and is recognized:—

SCALE OF POINTS.

Symmetry and type	25
Colour and plumage	8
Colour of comb, wattles, lobes, face, beak, legs and toes	4
Constitution	15
Shape of head and beak	4
Neck	2
Eye (colour and shape)	4
Shape and texture of face, comb, lobes and wattles	6
Breast	6
Back and shoulders	8
Abdomen	8
Tail	6
Legs and toes	4
TOTAL	100

Disqualifications.

The following disqualifications are given in the standard:—

(1) White in plumage, except where allowed.
(2) Red in feather.
(3) Side sprig.
(4) Red pearl or odd eyes.
(5) White in lobes of pullets and all males, also in females over 12 months showing more than ½ permanent white.
(6) Badly bent or crooked breast bone.
(7) Feather or fluff either on shank or feet.
(8) Crooked toes.
(9) Yellow in feet.
(10) Split wing.

It is considered necessary to give an explanation of the possible origin of the above disqualifications as this may enable poultry breeders and judges to give a correct interpretation of these disqualifying clauses in the standard:—

(1) In all black breeds of poultry the chicks at day-old age are black on the back with a white or yellowish-white colour in the lower parts of the body. The white colour is determined to some extent by a hormone present in the yolk of the egg. The yolk is absorbed by the chick at hatching time and slowly disappears. After the influence of the yolk is lost, black feathers replace the white down feathers. Young birds moult several times before they finally grow adult body feathers. During these various moults, the white colour in the feathers completely disappears, or only the white tips in the primary feathers remain. The variation in the colour of feathers is also inherited and possibly the white colour can be traced to the Black Plymouth Rock, Black Minorca and Black Langshan, the ancestors of the Black Orpington.

In young birds of either sex, slight indications of white tipping in the primary flight feathers of the wing are not a disqualification. In adult birds (cocks and hens) white ticking in the primaries is a disqualification, whereas faint white ticking on the head of an old hen is permissible.

In Jersey Black Giants positive white must show in the surface plumage before being regarded as a serious defect. According to the Amercan standard, which is slightly different from the South

African standard, Black Australorps can be disqualified if more than ½ inch of positive white appears in any part of the surface plumage or when two or more feathers are tipped or edged with positive white. For Black Wyandottes the disqualifying clause under plumage colour is approximately the same as for the Black Australorp.

(2) Red or brown feathers may appear in the progeny bred from parents with a rich green sheen in the feathers. Genetically black birds are buff in colour. When Black and White Australorps are crossed, a high percentage of the cockerels may exhibit red feathers in the hackle and saddle feathers. This is a definite indication that the recessive white colour has weakened or reduced the influence of the factor necessary for the extension of melanic pigment. Although a Black Australorp with a single red feather is disqualified at a show, it does not follow that one cannot breed from this bird. It has been accepted for many years that, if the lustre is deficient in the females of black breeds and varieties, it can be restored by the use of a male with a little red in the hackle. By the end of the first laying year most high-producing Australorp hens have a dull lustre in their feathers.

FIG. 4.—Original Australorp hens with black and white coloured feathers.

(3) A side sprig is sometimes present on a single comb and it is a well defined pointed growth on the side of the comb. This disqualification is inherited and if birds with side spigs are mated this trait may or may not appear in a large number of the progeny. Sometimes the blade of the comb is injured when two males are involved in a fight and a small point may become visible which should not be confused with a side sprig.

(4) Eye colour is inherited, but the various shades of iris colour may also be influenced by certain environmental factors.

In the three ancestors of the Black Orpington and also that of the Black Australorp the eye colours are as follows:—

Black Langshan:

Old standard: dark hazel to black, the darker the better.

Modern standard: dark brown to black, the darker the better.

In the Black Langshan, yellow or orange coloured eyes and yellow around eyes are recognized as serious defects.

Black Minorca: In both the old and modern standards, the eye colour is described as "dark" and no serious defects are given.

Plymouth Rock: In the old standard the iris colour is given as "bay", and in the modern standard as rich bay.

In the Black Australorp the eyes should be black, or black with a brown iris. There is a tendency on the part of some poultry breeders to be too strict in regard to the colour of the iris in this breed. It should be borne in mind that the Black Australorp is a comparatively new breed and that the bay iris, which was introduced through the Black Plymouth Rock, may appear in a modified form for many years. It is most important that the pupil should be sound in every respect. A split pupil is a serious disqualification, not only in the Australorp but in all breeds and varieties of fowls.

In the modern standard of the Black Langshan, an old breed and the chief ancestor of the Orpington, yellow or orange-coloured eyes are still recognized as a serious defect, and presumably this defect was introduced into the Langshan many years ago by another breed.

(5) According to the American Standard of Perfection, positive enamel white in the earlobes of males and females of American, Asiatic and English breeds (except the Chanticler, Dorking and Redcap) is a disqualification. The Chanticler is a breed with a cushion comb, and ¼ enamel white is allowed in the earlobes. The white in the earlobe was introduced through the White Leghorn, an ancestor of the Chanticler.

In the Australorp, enamel white was evidently introduced through the Black Minorca, a breed with prominent white earlobes. In the Australorp, most breeders are anxious to eliminate enamel white in the earlobes but in spite of careful selection this undesirable characteristic may appear in the progeny of red-earlobe parents. The inheritance of this characteristic is of a complex nature and in various crosses between red and white-earlobe breeds, neither enamel white nor red is dominant or recessive.

In judging, one should be quite certain that a bird has enamel white in the earlobes before the entry is disqualified or penalized. Some birds may have a pale colour in the lobes which is not positive or enamel white. In judging at various shows it has often been noticed that certain hens, especially those with a fine texture of the skin, can change their earlobe colour from red to a light colour and *vice versa*.

For an accurate determination of eye and earlobe colour it is most essential that the birds should be inspected in uniform light. If some birds are inspected in the shade and others in the sunlight an entirely different impression may be formed of the eye and earlobe colours. If electric light is used, the light may sometimes reflect an

entirely different colour from that which may be observed in daylight.

(6) A crooked breast bone is inherited but is in addition influenced by such factors as narrow perches and a lack of calcium and vitamin D in the ration of birds. By installing perches of 3 to 4 inches in width in poultry houses, much can be accomplished to reduce this defect to a minimum.

(7) The feathers which sometimes appear on the shanks or feet of Australorps are evidently inherited from the Black Langshan. In this breed the shanks and outer toes are feathered.

In a cross between the Black Langshan and a clean-legged breed, the first generation has feathered shanks and in the second generation the ratio will be 15 birds with feathered shanks and 1 with no feathers on the shanks.

(8) Crooked toes are often due to a structural defect. This defect interferes with normal walking and mating.

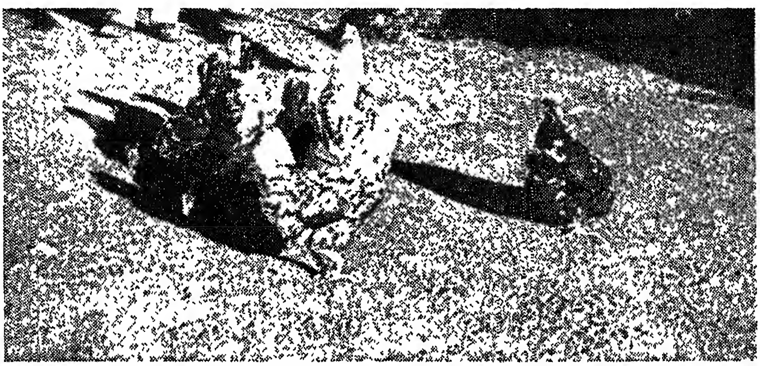

FIG. 5.—Some second-generation pullets which showed colour changes.

(9) In the Australorp the skin of the body and the soles of the feet are white, whereas in Jersey Giants the skin and soles of the feet are yellow. Apart from body conformation (type) the difference in skin colour is the chief distinguishing characteristic between these two breeds. Since both the Black Langshan and the Black Minorca have white skins, the defect (yellow) must have been introduced into the Orpington and Australorp by the Black Plymouth Rock.

(10) Split wing: The terms split wing and slipped wing are sometimes used synonymously. A split wing usually refers to a wing which is so irregularly formed as to show a decided gap between the primaries and secondaries while a slipped wing is one which is not closely folded and not held up in the proper position. The latter defect is caused by injury or weakness of the muscles of the wing.

A split wing is inherited and birds slected for breeding should not have this defect. When birds are moulting and the wing feathers are loose, it is difficult to identify a split wing accurately.

Productive Qualities of the Black Australorp.

In the Reliable Poultry Journal, January 1924, Mr. Kappler gave the following egg records, which were obtained at some of the egg-laying competitions in Australia. At the Geelong Contest,

1919-20, a Black Australorp hen of Mr. R. R. Christie's team of six birds laid 339 eggs. The team laid 1,733 eggs in 365 days. At the Geelong Egg-laying Competition, April 1922 to March 1923, six hens, entered also by Mr. Christie, laid 1,857 eggs in 365 days. The individual egg records of the birds were 330, 321, 314, 310, 298 and 284.

Outstanding records obtained in Australia are given in the following table:—

Name of bird.	Name of owner.	Name and year of egg-laying test.	No. of eggs per hen.
Peggy I...............	Robert Burns....	Gatton, Queensland 1917–18	335
Lady Elmo............	R. R. Christie....	Geelong, Victoria 1919–20	339
Record Queen..........	C. E. Graham....	Burnley 1917–18.........	335
No. 4.................	C. B. Bertelmeier	Geelong 1922–23..........	339
Peggy 2..............	Robert Burns....	Gatton 1919–20..........	335
Lady Consistent........	Robert Burns....	Gatton 1921–22..........	306

These birds were of good weight and produced extraordinarily large numbers of eggs. The body-weight in each case was about 5½ lb. when the test started, and by the end of the test each bird had gained about one lb. or a little more.

At the Papanui Egg-laying Competition, Christchurch, New Zealand, 1922-23, "Kismet Dot", a bird bred by Mr. James P. Drewitt, laid 343 eggs.

In South Africa the highest egg record is held by a Black Australorp, Hen No. 215, which produced 327 A-grade and 1 C-grade eggs in 336 days and 354 A-grade and 1 C-grade eggs in 365 days at the Glen Egg-laying Competition, 1944-45.

The average egg production of Black Australorp hens at the Glen Egg-laying Test for 7 consecutive tests is presented in Table 1.

TABLE I.—*Average egg production of Black Australorp at Glen Egg-laying Competion*: 48 *weeks.*

Year.	OPEN COMPETITION. Grade: Eggs.				BREEDERS' REGISTER COMPETITION. Grade: Eggs.			
	A.	B.	C.	Total.	A.	B.	C.	Total.
1940–41.....	171·5	30·7	1·0	203·2	186·7	23·2	0·7	210·6
1841–42.....	165·7	28·2	2·2	196·1	143·2	8·1	2·1	153·4
1942–43.....	173·4	24·0	1·6	199·1	187·4	29·4	1·1	218·0
1943–44.....	182·0	14·4	1·7	198·1	156·6	8·4	1·0	166·1
1944–45.....	188·0	11·2	0·8	200·1	203·8	22·4	1·4	227·7
1945–46.....	188·4	13·0	0·2	202·7	188·1	17·8	0·6	206·6
1946–47.....	179·1	19·3	1·6	200·2	171·8	19·9	1·8	194·6

Size of Eggs.

The Australorp can still be improved in regard to the size of eggs produced. During eight consecutive tests at Glen (1928-29 to 1936-37), 3,189 White Leghorns laid eggs of which 90·3 per cent. of the total were two-ounce eggs while 972 Black Australorps produced eggs of which 85·7 per cent. of the total were two-ounce eggs.

In the 1934-35 test, the average body-weight of Australorps was approximately 4½ lb. at the beginning of the test and 5 lb. 13 ounces at the end of the test. There is a close relationship between body-weight and the size of eggs produced and hence poultry breeders should not breed from undersized birds.

Live Body-weight of Australorp Chicks.

In the following table the average weights of both male and female chicks are given.

	Weight in Ounces.			
Weeks.	4	8	10	12
	ozs.	ozs.	ozs.	ozs.
Sex: Males	7·5	24·7	35·6	46·0
Females	7·1	21·6	30·2	37·5

On a good ration, Australorp cockerels will weigh from 3¾ lb. to 4 lb. at 16 weeks of age. They are docile and can easily be fattened.

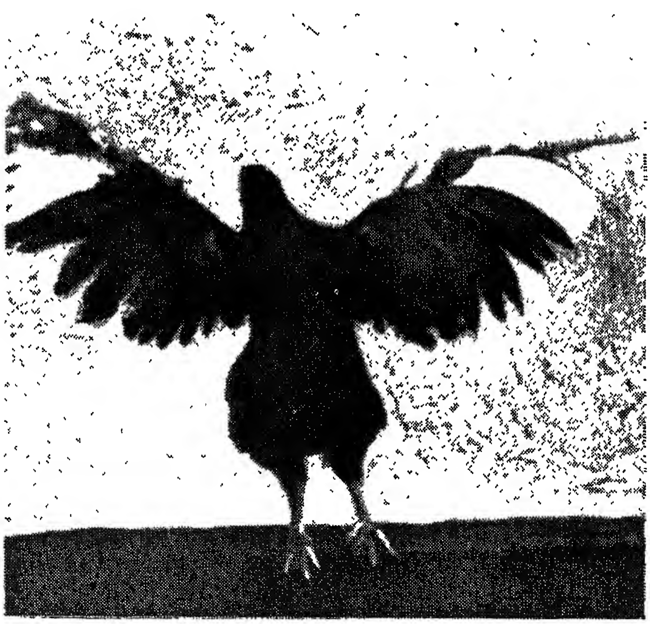

FIG. 6.—Second-generation pullets with white in wing feathers.

B. The White Australorp.

In 1936 Mr. N. H. Addison and Mr. D. Jacobs applied to the South African Poultry Association for the recognition of the White Australorp. Their application was accepted and the White Australorp was recognized as a new variety. The White Australorp is the only breed or variety of fowl which has ever been bred in the Union for commercial egg production. All other breeds and varieties of fowls known in the Union were bred overseas and imported into

this country. Two breeds, the Jacobean and Dieseldine were also bred and recognized in this country, but they have not advanced beyond the experimental breeding stage.

Origin of White Australorp

The White Australorp originated as a sport (mutation) from the black variety, and no other breeds or varieties were used for the production of this variety. The White Orpington, on the other hand, was produced by crossbreeding such varieties of fowls as the White Leghorn, Black Hamburg and White Dorking and therefore this variety is not a " sport ". The White Langshan originated as a sport from the black variety, the White Plymouth Rock from the barred variety, and the White Wyandotte from the silver variety.

Grootfontein Investigation

Colour changes in fowls have been reported by various research workers in different countries. In 1931 two Black Australorp hens at the Grootfontein College of Agriculture showed colour changes which were not accompanied by a moult and after the first annual moult in 1932 these birds were pure white in colour. These colour changes were reported by the writer in 1934.

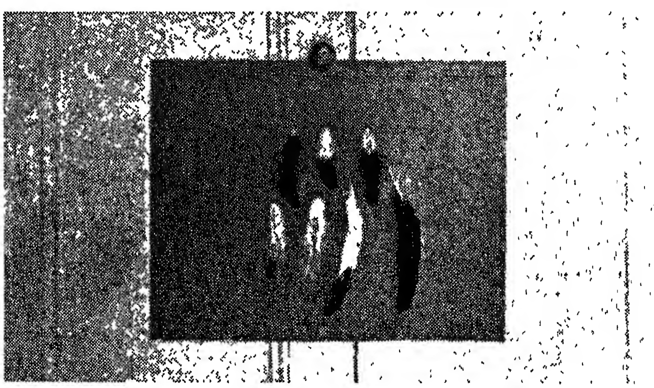

FIG. 7.—Depigmentation in the feathers.

In 1932 these hens were mated to a Black Australorp cock of a beautiful black colour with a green sheen. From this mating only 7 chicks were hatched and of these one female showed white feathers at the age of 6 months. At the age of one year this bird was pure white and representative of the dams in every respect. In 1933 the dams were mated to their sons and the brother mated to his sisters. From these matings 96 chicks were reared to 6 months of age and 5 pullets changed colour at the age of 4 to 5 months. After the first annual moult they were pure white in colour. The pullets far outnumbered the cockerels and as no colour changes were observed in the cockerels, it became clear that the male chicks which probably carried the white factor must have died in the shell. This pointed towards the presence of a lethal factor in White Australorp male chicks.

Colour changes in the Grootfontein strain of Black Australorps were observed in 1928 or even before that date by Mr. E. F. Lombard, who at the time was Lecturer in Poultry at the College. One R.O.P. Black Australorp cockerel bred at the College was sold to the Oakdale Agricultural School, Riversdale, and after the lapse of a few months

it was reported that this bird had developed white feathers. This bird was bred from an outstanding dam (No. 37), and her record was 292 eggs in the first laying year. It is most unfortunate that the R.O.P. cockerel should have been killed, because if chicks had been bred from this bird he would probably to-day have been acclaimed as the first male ancestor of the White Australorp.

On the transfer of Mr. Lombard to East London, the writer assumed duty at Grootfontein as Lecturer in Poultry (1931). Various buyers of stock reported that Black Australorps which originated from Grootfontein always produced a few progeny with black and white feathers as in Ancona fowls.

FIG. 8.—Buff Australorps bred by Mr. Addison.

When the writer informed Mr. Lombard about the position he stated: "I have looked upon these black and white coloured Australorps as crossbreds—probably a cross between White Leghorns and Black Australorps. We killed these birds but to me it is a mystery how the Leghorns and Australorps got mixed up. To both my assistant and myself this phenomenon has caused considerable confusion and worry".

In 1932 various Black Australorp hens and cocks at Grootfontein were fed thyroid extract and it was observed that the colour in black hens changed from a black to a dull and partly white colour. It was evident that under the influence of hyperthyroid activity changes in the colour of feathers could be brought about. Greenwood developed the theory that in the case of cocks the differentiation of the plumage is only dependent upon the thyroïd gland and not on the sexual gland. In the case of hens the functions of the thyroïd gland are increased through the influence of the ovary.

If fowls can be bred with small and large thyroid glands, as Riddle (1928) showed with pigeons, it is not impossible that colour changes in the feathers of black hens with hyper-active thyroid

glands could occur. In the sexually mature hen the ovary may also accelerate the functions of the thyroid gland and affect the metabolism of the newly developing feathers.

The experimental results at Grootfontein showed that these coloured Australorps were not crossbreds. The breeding results of Messrs. Addison and Jacobs definitely supported this viewpoint.

Mr. N. H. Addison of Middelburg, Cape Province, obtained Black Australorp breeding stock from the Grootfontein strain and in 1931 a few of the female chicks from this breeding also developed white feathers. These pullets became pure white and for several years he bred quite a number of white hens. Unfortunately all the cockerels bred from these white hens were of a black colour.

At approximately the same time Mr. Dan Jacobs of Germiston also bred a few white progeny from Black Australorps. He obtained both white pullets and cockerels. According to his records the first two White Australorp cockerels were bred in 1934 and they originated from the mating of R.O.P. Hen No. 1316 (254 eggs in 48 weeks) to R.O.P. Cock 1169 whose pedigree was as follows:—

Sire 1169.....	Sire 1218	Sire 1181
		Dam 502 (269 eggs)
	Dam 502 (269 eggs)	

From 1934 onwards several white chicks were bred from high-producing R.O.P. sires and dams. An excellent cockerel was bred by Mr. Jacobs from R.O.P. Hen No. 2135, a daughter of Hen No. 1517 with a record of 225 eggs. Mr. Addison also obtained a son of Hen No. 1517, and this bird was mated to white hens which originated from the Grootfontein birds and hens which he bred himself. All the records show that R.O.P. Hen 1316 and R.O.P. Cock 1169 are two important ancestors of the modern White Australorp.

White Australorp Standard.

The standard description of the White Australorp, with the following exceptions, is the same as for the black variety.

Plumage colour: White throughout. In judging, points will be deducted from the total score for such defects as brassiness and slight black ticking in the feathers. For solid black feathers in the flight and tail, birds must be disqualified.

The beak should be white or horn-coloured, the eyes brown or red, but the darker the eyes the better. The legs should be white in preference to slate, and birds with yellow or black shanks are disqualified. The toenails should be white or horn-coloured, the pad of the foot pinkish white, and the skin white. A slate colour of the pad is a defect and yellow is a disqualification.

The White Australorp can be improved in several respects:—

(*a*) For breeding purposes male birds with a pure white colour should be selected. Brassiness in males and black ticking or black feathers in both sexes should be eliminated.

(*b*) The legs should be white in preference to slate. The majority of White Australorps have slaty legs but, owing to the complexity of shank colour inheritance, it may take many years of careful selection before this colour is eliminated.

(*c*) The eye colour is not uniform and in most birds the eyes vary from shades of brown to red.

In the following table a comparison is given of the eye and shank colours of white varieties, excluding those with yellow shanks.

Name of White Variety.	Colour of eyes.	Colour of shanks.
Bresse	Black or dark brown	Slate blue.
Dorking	Reddish bay	Pinkish white.
Langshan	Dark brown to black	Light grey or slate.
Minorca	Red	Pink white.
Orpington	Red	White.
Sussex	Orange	White.
Polish (Bearded)	Reddish bay	Slaty blue.

From the table it will be seen that with the exception of the White Bearded Polish the white varieties with white or pinkish white shanks have red, orange or reddish bay eyes. If White Australorps are bred with white shanks, their eye colour will probably vary from red to reddish bay. If this alteration in the standard is allowed, the White Australorp will be similar in appearance to the White Orpington, with the exception that the latter is more loosely feathered than the White Australorp.

Egg Production.

White Australorps have been bred from high egg producers and in this respect they compare favourably with the black variety. At the Egg-laying Competition, Glen, 1943-44, the team entered by Mr. Jacobs came 5th in the heavy-breed section and at the Johannesburg Test in the same year his team came second, the entry of Mr. Victor Crankshaw of East London being first. The highest official records of individual hens entered by Mr. Jacobs at egg-laying competitions have been: 225, 228, 233, 235, 246, 256 and 258 A-grade eggs.

In general, White Australorp females do not produce as large-sized eggs as Black Australorps do. There is no fundamental reason why White Australorps cannot be bred for large egg size, and through trapnesting selection in this direction is proceeding rapidly.

As a table bird the White Australorp is superior to the black variety, because the carcase is white and does not show blue pin feathers underneath the skin. In the black variety dark pin feathers are most objectionable and detract from the market value.

The white variety may also be better suited to the hot climate in the northern provinces than the black variety.

Colour of Chick Down.

Various breeders have purchased White Australorp day-old chicks and have been disappointed to find that the chicks are not white but bluish gray. In the White Plymouth Rock and other recessive white breeds the down colour of chicks varies from bluish

gray to creamy white or white. Thus the colour of the White Australorp chick is not an exception to the rule. As soon as the flight feathers in this variety develop it will be noticed that these are white, and as the body feathers replace the down the chick develops into a white bird.

C. The Buff or Golden Australorp.

Mr. N. H. Addison commenced with the breeding of this variety in 1935. Black Australorps with red feathers in the hackle and saddle feathers were obtained from Mrs. B. J. van Niekerk, Rosslands, Colesberg, and by Mrs. P. A. Pienaar, Weltevreden, Colesberg. Birds of this description were also obtained by crossing White and Black Australorps. The introduction of recessive white weakened the factor necessary for the extension of black pigment to the feathers, and birds with various shades of brown and buff were bred. After selection and breeding for 10 years, Mr. Addison exhibited the Golden Australorps for the first time at the East London. Poultry Show in June 1945. They were not entered for prizes or awards as they are not a recognized variety.

The inheritance of the buff colour is of a complex nature and, as breeders of buff varieties know, it is most difficult to breed a bird with a uniform buff colour. In the Buff Australorp the body feathers have a uniform buff colour, but the colour of the wing and tail feathers is buff striped with black. The eyes are brown or red and the legs and feet are white.

Mr. Addison died on 9 June 1947 and through his death the poultry industry lost a leading poultry breeder. On 8 July Mr. and Mrs. O. Ramsay, "Harrison", P.O. Whittlesea, C.P., (son-in-law and daughter of Mr. Addison) proposed that the Golden Australorps, as the late Mr. Addison preferred to name them, should be taken over by the Agricultural Research Institute, Pretoria, for further breeding experiments. It was agreed to buy these birds at a nominal price and they arrived at the Experimental Farm on 12 August 1947. As soon as it is known that these birds are of uniform type and colour, application will be made to the South African Poultry Association for the recognition of this new variety.

ACKNOWLEDGMENTS.

The author wishes to express his gratitude to Messrs. Dan Jacobs and E. F. Lombard for the valuable information which they supplied on the origin of the White Australorp. The book "Fowls for the Times" was kindly presented to the author by Mr. E. J. Haskell, East London. As this book is out of print, this was a most valuable presentation.

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Farm Planning.

J. F. van Wyk, Horticultural Officer, Upington.

EVERY farmer is a primary producer. He is the head of his farming enterprise and the pivot around which every venture—successful or otherwise—revolves. Like the manager of a factory, the managing farmer must regulate, co-ordinate and harmonize the activities on his farm. The prerequisites for success are perseverance and a sound knowledge and study of the elementary basic principles of crop cultivation, treatment of animals, handling of labour and marketing. Farm planning is essential. The following are a few of the most important aspects of farming to which it applies:—

(1) *Choice of Crops.*—Owing to the differences in soil, climatological and geographical conditions, some crops can be more successfully cultivated in some areas than in others. The various crops even show varietal differences in respect of adaptability. The distances from the nearest market must also be taken into consideration. In view of the above, every farmer should regard it as his duty to have a thorough knowledge of the crops best suited to his particular conditions. The agricultural officers for the area concerned are at the farmers' service and will furnish the necessary advice.

(2) *Crop rotation.*—Within his own enterprise every farmer should plan an effective rotational system adapted to the rest of his farming. Particularly where animals constitute an important part of the enterprise, provision will have to be made for fodder production. Moreover, such a rotational system must be constructive in so far as the soil is concerned. An effective rotational system is not one where the crop succession depends purely on chance, but one planned ahead, with a view to the most effective soil utilization, with due regard to both fertility and economy.

(3) *Animals as Part of the Farming System.*—There is a growing need on most farms for the acquirement of sufficient quantities of manure from elsewhere. Where this is not yet the case, it is therefore imperative when planning a farming enterprise, to pay more attention to the animal factor with a view to maintaining the manure supplies on the farm.

(4) *Division of Labour.*—Although this matter actually falls under the heading, choice of crops, it is of such importance as to call for a separate discussion. Scarcity of labour is a serious problem in many cases. Mechanization of the farm *wherever necessary* is becoming essential. Available labour should be utilized *as economically as possible* and the choice of crops such, that an effective seasonal distribution of the available labour will be ensured. The farmer must always remember that he is not a labourer in the true sense of the word, but the manager of his enterprise.

(5) *Purchase of Farm Requirements.*—The well-planned and timely purchase of implements, fertilizer, seed, insecticides, fungicides, bags, wire, etc., is of the utmost importance. Much trouble and disappointment can be avoided by making the necessary provision. To-day especially, with most farm requirements in short supply, special attention should be given to this matter. When introducing improvements, care should be taken to see that they are within the limits of the income and the actual requirements.

 [*Continued on page* 64.

Brickmaking on the Farm.

A FIRST-CLASS brick can be made on many farms if a little care and foresight are exercised. To obtain the best results the farmer should—prior to the commencement of the actual work—conduct a series of simple experiments.

Selection of Site for Brickyards.

The farmer should have a good idea where suitable brick-earths are obtainable on his farm. A likely place is at the foot of a hill where the soil is of a clayey nature. In the course of centuries, fine gravel has been washed from the hill-slopes and deposited among the clay and sand, and the resulting mixture is often admirable suited for the making of bricks.

The following considerations should influence the choice of the site, so that labour may be minimized and, if possoble, excavations may be made where they may be useful:—

(1) Near a dam; thus a plentiful supply of water is assured and the excavation enlarges the dam.

(2) Near the farmyard, so that the excavations may be utilized for the underground part of a tower silo, pit silo, manure pit, reservoir, cattle, sheep or pig dip, or such-like.

(3) Near the farmhouse, where the excavation may facilitate the levelling of a tennis court, etc.

(4) Where the cartage of materials, that is, sand, gravel, ash, fine coal, coal for burning, and water is reduced to a minimum, thus reducing the cost of production.

Testing Brick-earths.

Bricks are made from suitable earth consisting of, roughly, four parts of clay to one part of sand—called brick-earth. Select several samples of brick-earths from various sites, puddle each sample thoroughly, that is, add water and work until plastic, and then mould six miniature bricks, say the size of a match-box, from each sample. Allow the bricks to dry in the open, protected from strong sun, drying winds, and rain, or under the same conditions in which it is intended to dry the actual bricks, and provide each set of test bricks with a distinguishing mark. After the test bricks are thoroughly sun-dried, examine each carefully, so that a rough idea can be formed as to which samples are likely to produce good results. During the initial drying some of the test bricks will develop cracks, thus indicating the presence of too much clay, or too rapid drying.

The burning of the test bricks which have survived the sun-drying process may be accomplished inside an old drum, steel barrel or similar receptacle, as follows:—

Erect a rough fireplace of full-sized bricks, leaving plenty of spaces between the bricks to allow the air to reach the fire. Remove one end of the drum and perforate the bottom and sides with large holes from the inside. Place the drum above the fireplace and arrange the test bricks in layers within the drum so that small coal surrounds each test brick. Plaster the outside of the drum with clay, which is keyed to the drum by means of the perforations, to conserve the heat and increase the draught. Ignite the fire and regulate the draught, so that a steady heat is obtained within the

* Compiled by J. W. Cleghorne, formerly Senior Engineer, Division of Soil Conservation and Extension.

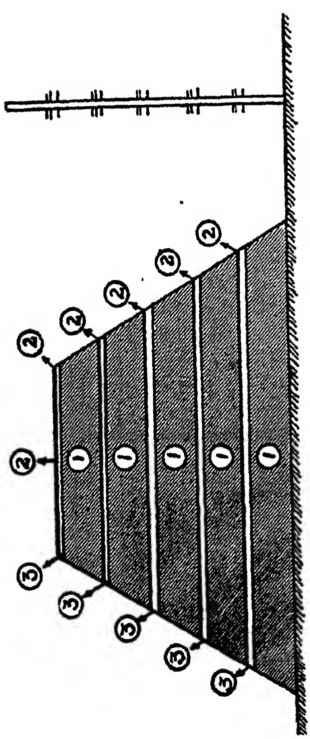

Fig. 1.
Heap of ingredients with measuring rod at the side.

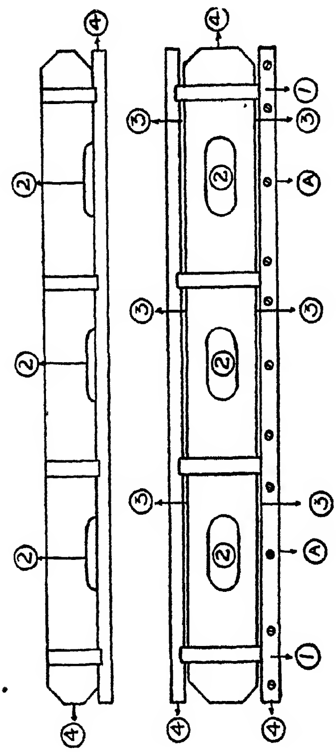

Fig. 2.
Mould for making green bricks.

drum, thus ensuring that the test bricks will receive, as nearly as possible, the same treatment as the actual bricks receive during burning. Allow the drum to cool slowly and do not remove the test bricks until they are cold. Examination of the test bricks will reveal which samples of brick-earth will produce satisfactory bricks.

The farmer, by close observation of the test bricks, is enabled to judge, approximately, the amount of shrinkage that takes place during the sun-drying and burning. This information provides some idea of the necessary shrinkage allowance to be made in constructing the moulds for the full-sized bricks.

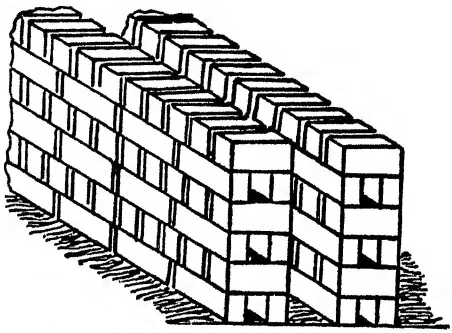

FIG. 3.—How the green bricks are stacked to complete the drying process.

The following points must be borne in mind when examining the test bricks:—

(1) The results obtained when burning full-sized bricks in a large clamp will be much better than in the case with the test bricks.

(2) The heavier and denser the sample, the better.

(3) If the burnt sample is brittle, it may be due to under-burning or to the presence of too much sand.

(4) After the selection of the best test brick, note the proportions of the ingredients carefully, so that the full-sized bricks may be mixed accordingly.

Preparation of Site.

Prior to the commencement of the actual brickmaking, the selected site should be cleared of all vegetation, particularly the parts where the excavation is to be made, and where the "green" (unburnt) bricks have to be sun-dried. The sun-drying site should be levelled, because surface irregularities cause mis-shapen bricks. The entire site should be protected from flood water by means of an earthen bank, and the materials removed during clearing and levelling could be used for this purpose. The site of the clamp should be hard and level, and near the drying site so that labour is reduced. If a separate gravel pit is necessary, have it as near the brickmaking site as possible.

It is quite possible to obtain a brick-earth containing all the necessary ingredients—sand, clay and gravel—from one pit. The gravel, which should contain iron oxide, acts as a flux, that is, it melts during the subsequent burning, promotes the partial fusion of the brick-earth and increases the tendency to vitrify, thus producing a stronger brick.

When the brick-earth is being dug, the excavation should, if possible, be made deep, so that the natives have a vertical face at which to work. To facilitate the work of excavation a small sloot may be made about one foot back from the edge of the excavation.

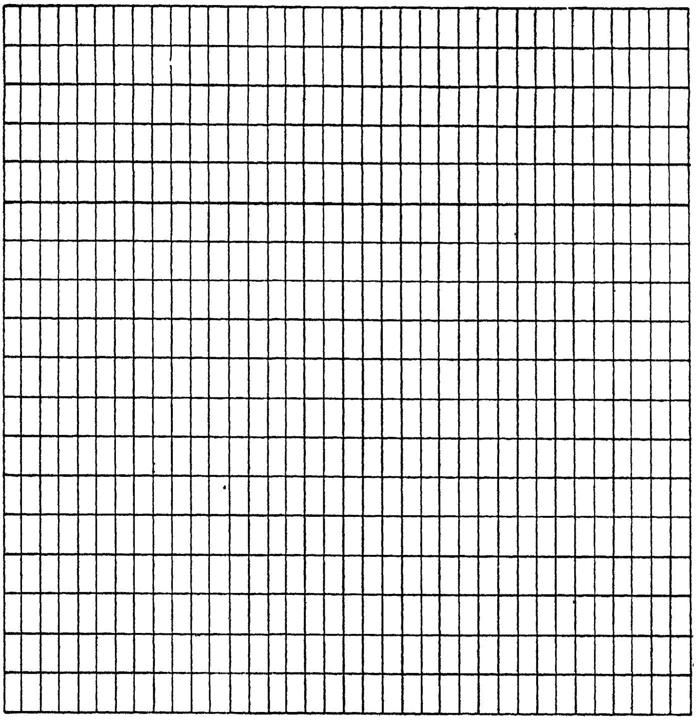

Fig: 5.

Second or fire-grate layer of the clamp.

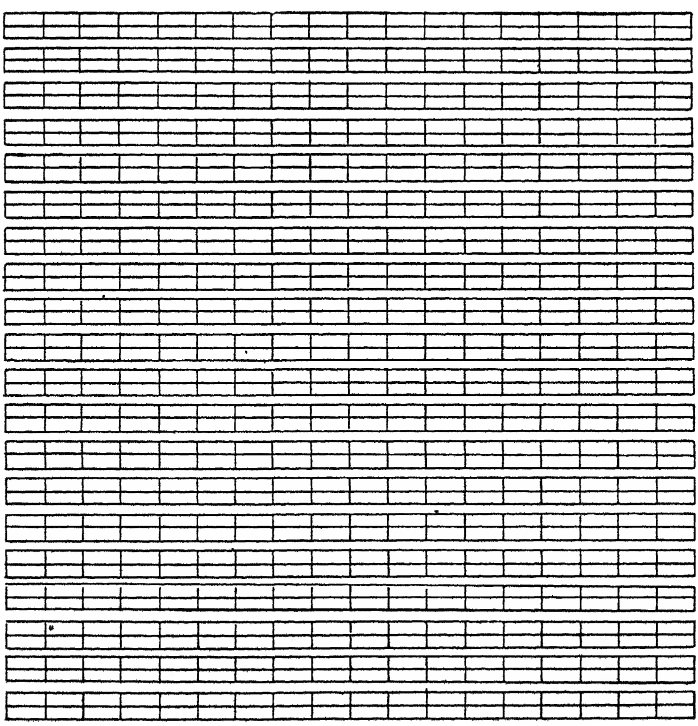

Fig: 4.

First or foundation layer of the clamp.

This sloot is allowed to stand full of water which percolates through the soil to the bottom of the excavation, thus reducing the labour necessary for the removal of the brick-earth. During the excavation of the brick-earth all stones are removed, and the brick-earth is puddled and deposited in a layer near the pug-mill.

Mixing of Materials.

The layer of puddled brick-earth is covered with a thin layer of finely sifted gravel. The thickness of the layers is decided from the proportions of each used in the selected test brick. The addition of coal dust or finely sifted ash facilitates the subsequent burning and it should be added at this stage of the work. It is not advisable to add more than 8 per cent. of coal dust or ash owing to the danger of over-burning. The coal dust or ash is added in a layer, above the gravel layer. Additional layers are now added in the same rotation until the heap is the desired height, usually not more than 5 feet to enable the tug-pole of the pug-mill to clear the top of the heap. Water is added as necessary during the placing of the various layers. The necessary ingredients have now been distributed in the correct proportions throughout the heap. Now commence the removal of the heap at the side next the pug-mill. Water is added as required and the materials are thoroughly mixed before being delivered to the pug-mill. To procure efficient mixing and to ensure thorough distribution of the ingredients throughout the mass it is necessary to remove the heap in vertical slices. Use a measuring rod during the deposition of the layers. A piece of wood with nails driven in at the proper distance apart is quite suitable, or if something more substantial is wanted a rod of iron with pins inserted into holes drilled to receive them, will serve the same purpose. Fig. 1 shows the heap of ingredients and the measuring rod. The measuring rod can be buried vertically in the middle of each heap. In the figure, 1 is brick-earth, 2 is coal dust or ash and 3 is gravel.

In the event of the absence of a pug-mill, the mixing can be carried out by wielding shovels and tramping the mixture.

Making of the Moulds.

The triple form of mould has proved to be the most suitable owing to the lighter weight to be transported. Each compartment of the mould measured $9\frac{1}{2}$ in. by $4\frac{5}{8}$ in. by 3 in., which with a particular brick-earth produced a finished brick measuring 9 in. by $4\frac{3}{8}$ in. by $2^{13}/_{16}$ in. The moulds first used were made of hard wood, $\frac{3}{4}$ in. thick, with bottoms of ceiling board, but later the entire construction was of hard wood and produced better results. The insides of the moulds are slightly tapered and very smooth, to facilitate the removal of the moulded bricks. Such a mould is illustrated in Fig. 2, and the numbers of the figure represent: (1) Hoop iron nailed securely to the upper surfaces. Only that on side A is shown. If this iron is not used the upper edges of the mould, between each division, wear very quickly owing to the use of the "strike". The strike is a straight piece of wood used to cut off the superfluous brick-earth which protrudes above the mould. (2) Projections on the bottom of the mould to form the frogs or depressions on the bricks. (3) Spaces, $\frac{1}{8}$ in. wide, to permit of the escape of air when the mould is filled, thus ensuring the complete filling of the mould. (4) Extensions which form handles. The upper figure of Fig. 2 is a side elevation with the side A of the mould removed, and the lower figure is a plan with the hoop iron shown in position on side A only.

The slop method is recommended. That is, the mould is dipped into water prior to filling. The brick-moulder works in a pit about

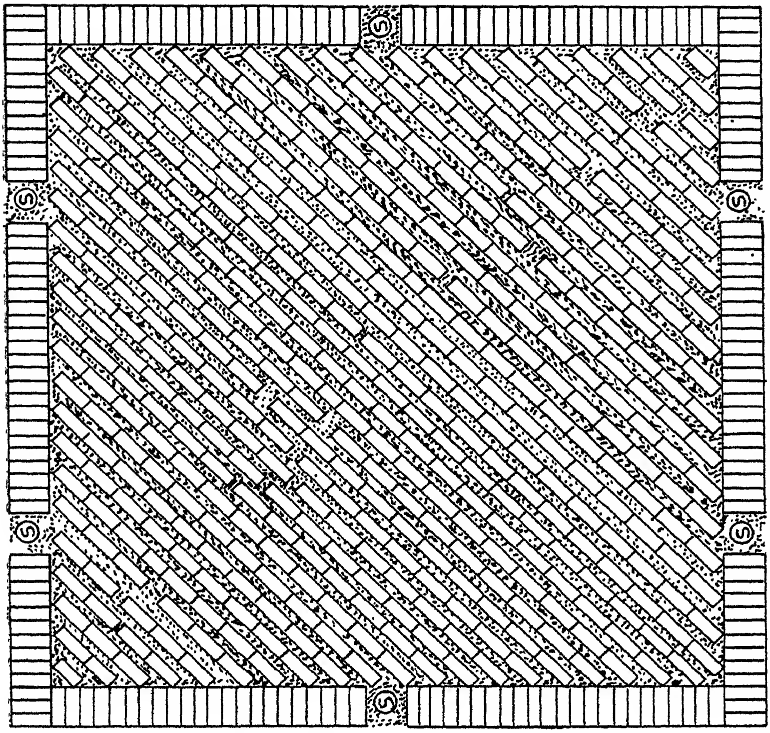

FIG: 7.
Fourth layer of clamp.

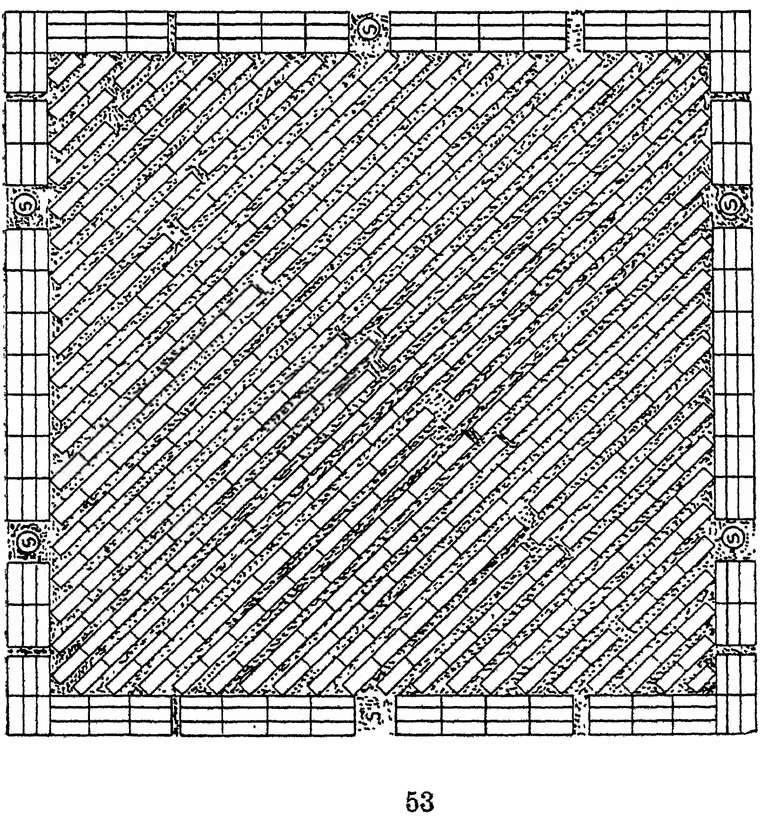

FIG: 6.
Third layer of clamp.

3 feet deep, and the moulding table consists of two planks laid on the ground surface in front of the pit at a convenient working height. Alongside the pit within easy reach of the brick-moulder a barrel for the storage of water is sunk in the ground. If a pug-mill is used it should discharge the puddled brick-earth on one end of the moulder's table. The moulding should be done as near the drying site as possible.

Moulding.

The moulder takes a mould out of the water in the barrel and places it on the moulding table. Sufficient brick-earth to more than fill one compartment of the mould is picked up from the table and is thrown violently into the mould so that the air is forced out through the gaps (3 in Fig. 2) at the bottom of the mould, and the corners of the mould are completely filled. After the three compartments are filled the strike is used to cut off the surplus material. If the strike is used at an angle, thus obtaining a sliding cut, the resulting cut is much cleaner, i.e., smoother, than is the case when the strike is drawn straight across the mould. The full mould is then carried to the drying site and placed on the ground, bottom upwards. The fingers of the bearer should now be quickly run along both edges of the piece of wood which forms the bottom of the mould, that is above each gap, so that the narrow strip of brick-earth, which protrudes is removed. If this precaution is not taken it means that a ridge will exist along each top corner of the finished brick, which is undesirable from the building point of view, and further, the ridges injure the hands of the bricklayer.

With a new mould a little trouble may be experienced in getting the " green " bricks to leave the mould easily and cleanly. Inspection of the mould will soon reveal the cause of the trouble. If the " green " bricks are inclined to cling to the moulds a series of light taps with a stone on the bottom, now uppermost, of the mould, will dislodge them. Lift the mould vertically to prevent distortion of the bricks.

Drying of Bricks.

The bricks are deposited in rows as close together as possible on the drying site to conserve space and necessitate less protective materials in the event of rain. Any material is suitable for this protective covering, such as grass, weeds, corrugated iron or old sacks. The last-named are considered best because they hug the bricks more closely. The bricks are allowed to remain undisturbed until they are hard enough to allow of their being tipped over on their 3-inch sides without the corners on which the brick is turned being rounded, which often occurs as a result of the brick being too soft to withstand its own weight.

As soon as the bricks are hard enough to handle they are stacked as shown in Fig. 3, to permit of the rapid completion of the drying process. The stacks should be in the form of a square, 10 bricks high, which enables a maximum number of bricks to be covered with a minimum amount of protective covering in the event of rain. If desired, the stacks may be higher than 10 bricks, but there is a danger of the bricks forming the lower layer being crushed by the superimposed weight. If necessary to protect from rain, sheets of corrugated iron are placed on top so that the edges of the iron extend beyond the edges of the stack, thus enabling sacks to be suspended therefrom as a protection against driving rain. Protect the bottom of the stack from surface water, otherwise the bricks comprising the bottom layer will become wet and the stack will collapse. If a shed is available the bricks may be stored therein to await burning.

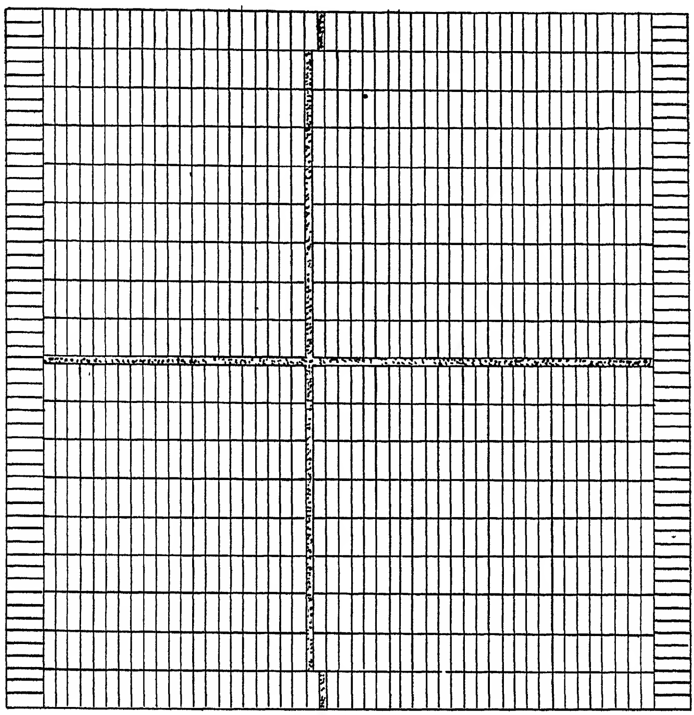

FIG: 9.
Sixth layer of clamp.

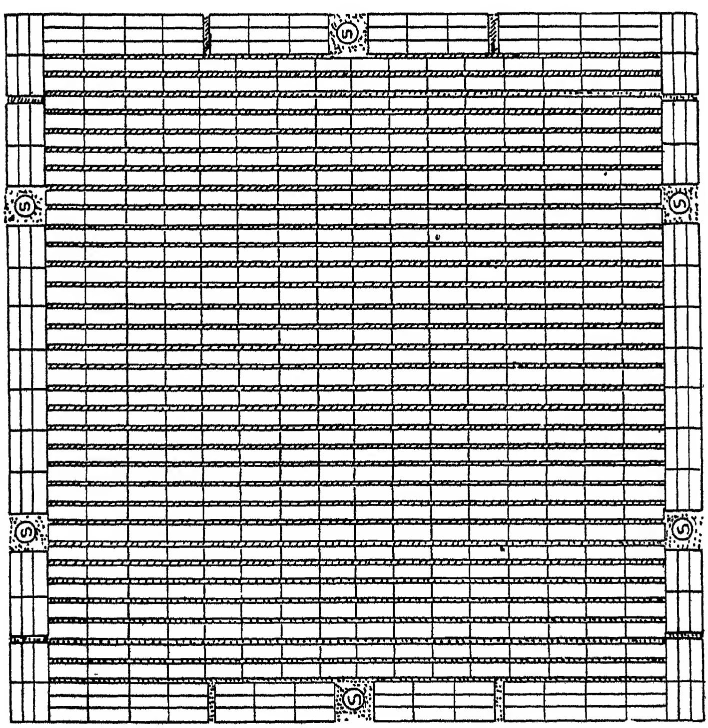

FIG: 8.
Fifth layer of clamp.

Clamp Erection.

Bricks which are not thoroughly dried should not be built into the clamp, because during the burning the moisture from the damp bricks is driven off by the heat and will wet the dry bricks above. Care should be taken to bond or tie all the bricks comprising the clamp together, especially in the casing, or protective covering which surrounds the clamp.

A casing 9 inches thick is better than one of 3 inches, there being less loss of heat during the burning process.

Every brick in the clamp is placed on edge, with the exception of the fire-grate layer, which, to economize in bricks, is constructed of bricks on flat. The coal and ashes used for fuel are incorporated in the clamp during its erection. The aim of the farmer should be to generate sufficient and *uniform* heat throughout the entire clamp to efficiently burn the whole clamp, and this aim can only be achieved by careful and judicious distribution of the fuel throughout the clamp.

Build the clamp as high as possible—consistent with economy in labour—because the heat generated in the lower layers ascends, and thus less fuel is necessary in the upper layers.

All bricks in any layer throughout the clamp are at right angles to the bricks in the layers immediately above and below it, excluding layers 2, 3, 4 and 5. The base of the clamp should be square so that the number of bricks necessary for the casing is reduced to a minimum. The number of bricks in a clamp may range from 10,000 to 75,000 or more. The following is a description of a clamp 14 feet square at the base and 14 feet high, containing 23,000 bricks. This method can confidently be recommended for use on the farm.

Layer 1.—Air or foundation layer. Place old burnt bricks, discarded from a previous burning as useless for building purposes, in double rows on edge, with 2-inch spaces for air in between each double row as shown in Fig. 4. In the absence of burnt bricks, sun-dried bricks must be used in this course, also in course 2 and for the casing.

Layer 2.—Fire-grate layer. This layer consists of inferior burnt bricks packed close together on flat. (Fig. 5.)

Layer 3.—Complete fire-layer. Unburnt bricks are deposited diagonally in single rows with 2-inch spaces between the rows. During erection these spaces are filled with a 1-inch thick layer of small wood chips and shavings, with cubes of coal above. The coal should not be packed tightly nor should it be too fine, otherwise the draught will be restricted. The casing is built as shown, spaces 9-inch wide (S in Fig. 6) being left at intervals to accommodate the kindling fires for ignition of the clamp. The number of kindling fireplaces may be increased according to the size of the base of the clamp.

The spaces between the unburnt bricks and the casing, in every layer, are filled with coal. (Fig. 6.)

Layer 4.—Complete fire-layer. This layer is the same as the previous one, all bricks being at right angles to those on the layer below. All spaces are filled with coal cubes. (Fig. 7.)

Layer 5.—Complete fire-layer. The bricks are laid in rows parallel to two opposite sides of the clamp, with 1-inch. spaces between the rows for smaller coal than that used in the previous layers. In layers 4 and 5 spaces are also left for kindling fireplaces. (Fig. 8.)

Layer 6.—Close-packed layer. Any small spaces which may occur in this layer are filled with coal and no spaces are provided in the casing for fireplaces. The outer dimensions of this layer

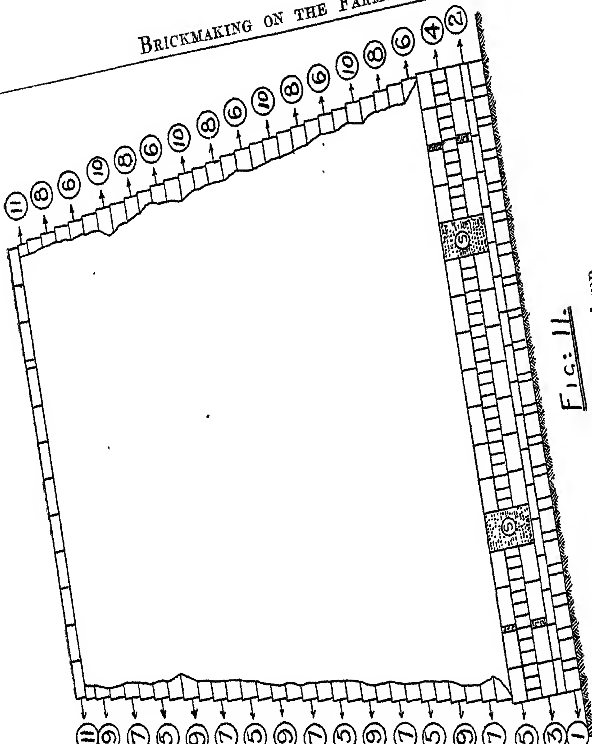

FIG: 11.

The completed clamp.

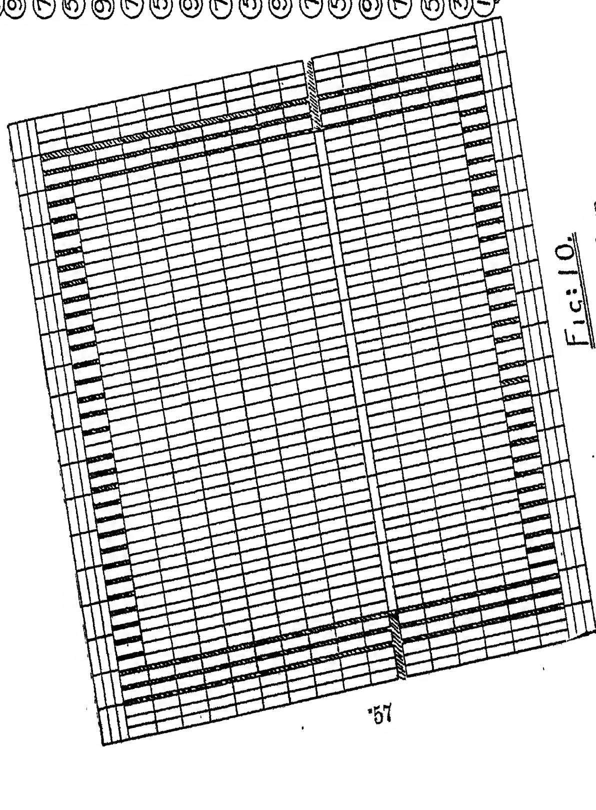

FIG: 10.

Seventh layer of clamp.

are made 2 inches smaller than the previous layers, and every subsequent layer is treated in the same manner, so that the clamp tapers towards the top and is much more stable as is obvious from Fig. 11.

Layer 7.—Partial fire-layer. All the bricks are close-packed, with the exception of the outer row on two sides and the outer two or three rows on the remaining two sides, all of which rows are provided with 1-inch spaces for small coal or good ashes. (Fig. 10.) The idea of this arrangement is to admit of heat being generated near the outside surfaces of the clamp where invariably insufficient heat is generated in spite of over-burning in the middle of the clamp.

Layers 8. 9 *and* 10.—Partial fire-layers. These layers are arranged in the same manner as layer 7 (Fig. 10), except that the bricks forming each layer are at right angles to the bricks in the layers immediately above and below the layer concerned.

Remaining Layers.—The clamp is built to the required height by a repetition of layers 5 to 10 inclusive. In every complete fire-layer coal is used as fuel, and in all partial fire-layers the fuel used is ashes. Layer 11 is a protective layer. (See Fig. 11.) The shaded portions in Figs. 6 to 10 inclusive represent fuel.

The top of the clamp is protected by one or two layers of broken or misshapen "green" bricks or with old burnt bricks. A heap of ash is placed centrally on the top of the clamp so that it is available when necessary, that is, when the clamp is well alight, to spread over the top of the clamp, to retard combustion and prevent loss of valuable heat. The sides of the clamp are plastered with clay so that the air necessary to promote combustion can only gain access to the clamp through the kindling-fireplaces and from the bottom of the clamp.

Burning.

The lower five layers may be left unplastered until the clamp is thoroughly well alight. Layers 1 and 2 are not plastered, so that air finds easy access into the complete fire-layer number 3.

In the event of too rapid burning the spaces around the air or foundation layer can be closed by shovelling ash or soil against the edges of the layer. The six kindling fires are all set alight at the same time. The draught will draw the flames right into the fire layers 3, 4 and 5. After the clamp is burning briskly the kindling-fireplaces are closed and the draught regulated from the air or foundation layer. Cracks which develop in the plaster during burning should be filled immediately. In the event of very wet weather during the burning process the top of the clamp may be further protected by grass, straw, or old corrugated iron sheets.

The clamp is allowed to burn until the fuel is consumed, and the time necessary depends on the following:—

(1) The quantity of fuel used, and its close packing or otherwise.
(2) The regulation of the air supply to the air or foundation layer and through the kindling-fireplaces.
(3) The weather experienced.
(4) The immediate closing of all plaster cracks.
(5) The covering of the top of the clamp with ash.
(6) The size of the clamp.

Allow the clamp to cool slowly and do not dismantle it until cold, because if the bricks are removed when hot, cracks tend to develop as a result of the consequent sudden and unequal contraction.

If the clamp is erected by the method described, one and one-eight bags of coal and half a bag of selected ashes will be sufficient to burn one thousand bricks.

The Farm Home.

(A section devoted mainly to the interests of Farm Women.)

Pickles, Relishes, Sauces, and Chutneys.

Miss. N. Retief, Home Economics Officer, Pretoria.

WHEN the bulk of essential canning is done, and the shelves of the preserve cupboard are stocked with jars of fruits and vegetables, it is time to start the pleasant task of pickling. Then come the days when a tantalizing sweet, spicy fragrance drifts from the kitchen. With home-made pickles, relishes, chutneys and sauces to call upon, the ordinary meal can be lifted above the commonplace to the level of a feast.

The preservation of food with salt or vinegar, either with or without the addition of spices and sugar, is commonly known as pickling. This is a simple process and may be completed in one day, or the ingredients may first be allowed to "ripen" before they are pickled. This process is known as *curing.*

The curing process causes colour, texture, and flavour changes. Pickles which are made from cured vegetables or fruits have a better flavour, crisper texture and more attractive colour than those made from vegetables that have not been cured.

Products for Pickling.

Cucumbers, tomatoes, onions, beetroot, carrots, cauliflower, cabbage, peaches, pears and apples are the vegetables and fruits most often used for pickling.

Vegetables and fruits for pickling should be young and fresh. If they are green or slightly underripe, they make firmer, crisper pickles than ripe fruit or vegetables do.

Salt.—Use a salt solution (brine) in preference to dry salt in the curing process. Dry salt is inclined to cause the fruits and vegetables to shrink and toughens them. Never use hard water to make the brine because the iron in it turns the pickle black, and the other mineral salts interfere with the curing process. Use boiled rain water, if obtainable. If this is not available, soften hard water as follows:—

Boil, cool, and strain through several layers of cheese-cloth. Also add 1 T. vinegar to each quart of water. The amount of brine required is ½ to ⅔ of the volume of the vegetables.

Vinegar.—Cider and malt vinegar are useful for their flavour, but they do not give an attractive colour to the pickles. On the other hand, white grape vinegar gives a good flavour and a clear pickle. It is the best to use for cauliflower and onions. Vinegar improves the texture by making the pickles crisp. If the vinegar is too strong, however, it will cause them to shrink. Vinegar gives the desired sour flavour to pickles.

Sugar and Spices.—Too much sugar causes the vegetables to shrink. White or brown sugar may be used. Spices should never be used in quantities large enough to conceal the original flavour of the fruit or vegetables.

Utensils.—All utensils used should be earthenware or porcelain, or enamel lined, without cracks or chips. Saucepans should be wide and shallow to ensure even cooking. Wooden or enamel spoons should be used. Store the finished product in glass or earthenware, and never allow any metal to come into contact with it.

General Method of Pickling Vegetables.

In most cases both salt and vinegar are used in making pickles. After the preliminary preparation, such as cleaning and cutting into suitable sizes, the vegetables are put into the brine (1 lb. salt to 1 gal. water). They are then left for 1 to 14 days, or as indicated in the recipe. Some of the water will be drawn from the vegetables, thus making them firmer and enabling them to absorb spiced vinegar more easily later on. The withdrawal of the water will also prevent their softening in the pickling mixture, and the salt checks spoilage. The brine should be cool before it is poured over the vegetables, and care should be taken that the vegetables are thoroughly immersed.

After the vegetables have been under the brine for the required length of time, drain them well and treat them with spiced vinegar or as indicated in the recipes. The spices may be used either whole or ground according to whether a clear or dark pickle is required. The spices may be tied in a small muslin or calico bag, and removed from the vinegar before it is poured over the vegetables.

Ripening.—Pickles should never be used before they are thoroughly ripened. This takes from 1 to 2 months. The material becomes firm and translucent, and the colour of green vegetables turns from a light to a dark olive-green. The change of colour should be uniform.

Faults frequently found in Pickles, and their Causes.

Soft, slippery pickles.—These may be caused by:—

(*a*) The vinegar or brine being too weak. Vinegar loses its strength if it is boiled too long. To maintain the strength of the salt solution during fermentation, add salt from time to time as directed in the recipe.

(*b*) Storage in too warm a place.

(*c*) Exposure to air above the brine or vinegar. The pickles should be covered by at least one inch of liquid.

(*d*) Cooking pickles too long.

Hollow pickles.—These float on the brine when there is too long a delay between the picking of the vegetables and the brining. Not more than 24 hours should elapse before they are put into the brine.

Shrivelled pickles.—These occur when the brine or vinegar or sugar solution is too strong at the start. It is best to begin with a weak solution and follow with a stronger one.

Selected Recipes.

Spiced Vinegar (I.)

3 pints vinegar;
1 T. whole allspice;
1 T. mustard seed;
1 T. clove stalks (no heads);
½ T. stick cinnamon.

1. Tie the spices in a muslin bag, add to the vinegar and bring to the boil.

2. Remove to the side of the stove and allow to stand for about two hours. Then remove the spices.

Spiced Vinegar (II) (for pickled onions).

½ gal. vinegar;
1½ T. celery salt;
½ c. grated horse-radish;
½ T. whole allspice;
1 c. sugar;
1½ T. mustard seed;
1 T. salt;
1 T. stick cinnamon.

(1) Tie the spices in a muslin bag, add to the vinegar and sugar and bring to the boil.

(2) Move to the side of the stove and leave for two hours.

Pickled Onions.

Select small white onions. Peel, cover with fresh water and allow to stand for two days, changing the water on the second day. Wash well and put into the brine for four days. Remove from the brine and drop into boiling water. Leave for 10 minutes, and then put into cold water for two hours. Drain and pack in jars, putting in a few small red chillies and a few bits of mace. Fill the jars to overflowing with hot spiced vinegar.

Mustard Pickles.

1 large cauliflower;	3 green sweet peppers;
2 pints small onions;	3 red sweet peppers;
4 pints vinegar;	1 cabbage;
1 c. meal;	2 T. mustard;
4 pints green tomatoes;	1 T. turmeric;
4 pints ripe tomatoes (firm);	1½ c. sugar;
2 lb. cucumbers;	Salt, water.

1. Slice the tomatoes, peel and slice the onions and cucumbers.
2. Chop cabbage and separate the cauliflower.
3. Put into a brine solution, using ½ c. salt to 10 pints water. Allow to stand for 24 hours.
4. Drain well and steam until nearly tender.
5. Mix all the spices and meal, and add enough water to make a paste.
6. Add two cups of boiling water, and add to the boiling vinegar. Cook until very thick. Add the vegetables and mix well.
7. Pack hot and seal.

Yellow Peach Pickle.

6 lb. yellow peaches;	1 dessertspoon salt;
2 bottles vinegar;	2 T. coriander seed;
4 small chillies, cut up;	2 T. curry powder;
3 large onions;	1 T. whole allspice;
½ cup brown sugar;	1 T. peppercorns;
1 t. turmeric;	1 T. maize flower.

1. Put vinegar on the fire together with spices tied in a muslin bag, and bring to the boil.
2. Mix sugar, maize flour, curry powder, turmeric and salt. Add the hot vinegar after removing the spices, and stir until smooth.
3. Bring to the boil, add onions, peaches and chillies, and boil for about 10 minutes.
4. Remove the spices and bottle the mixture.

Relishes.

Relishes are made of a mixture of vegetables and fruit which are chopped fairly finely, and cooked with vinegar and spices until they are tender but not soft. The mixture must be firm. Relishes are also known as " Chow-Chow ".

Bordeaux Relish.

1 gal. green tomatoes;	½ oz. celery seed;
1 head cabbage;	4 ozs. mustard seed;
10 onions;	1½ c. brown sugar;
2 green peppers;	½ gal. vinegar.
2 T. turmeric;	

1. Chop tomatoes, cabbage, and onions.
2. Arrange in earthenware dishes with layers of salt. Leave overnight. Then drain *well*, or the pickle will be too salty.
4. Bring the vinegar, sugar, spices and chopped peppers to the boil, add the vegetables and cook till they are tender.
5. Bottle immediately, and seal.

Chow-Chow.

12 small cucumbers;	2 quarts string beans;
2 quarts small green tomatoes;	Salt;
3 sweet red peppers;	4 ozs. mustard seed;
1 cauliflower;	2 ozs. turmeric;
2 green peppers;	½ oz. allspice;
2 bunches celery;	½ oz. pepper;
2 cups small white onions;	½ oz. cloves.
1 gal. vinegar;	

1. Cut vegetables into small pieces and combine.
2. Put layer of vegetables in earthenware dishes and sprinkle liberally with salt. Repeat until all the vegetables are used.
3. Allow to stand for 24 hours. Drain well.
4. Combine spices and vinegar and bring to the boil. Add vegetables and simmer until vegetables are soft.
5. Fill boiling hot into sterilized bottles. Seal at once.

Chutneys and Sauces.

Individual taste and ingenuity in combining ingredients to give distinctive flavours may be exercised here. Acid fruit such as apples, tomatoes, plums and quinces are good bases for sauces and chutneys. Onions, garlic, raisins, dates, sugar and spices are added according to taste, and the whole mixed with vinegar. The vinegar and spices are the preserving agents. A good vinegar should be used.

A *chutney* is a thick cooked pulp, which is made from finely chopped vegetables and/or fruit, with the addition of vinegar and spices. The finished product should have the consistency of a soft jam. The flavour of the spices is usually strong, but should not be so strong as to disguise the natural flavour of the ingredients. Chutneys and sauces should be stirred occasionally to prevent burning. The same type of utensil should be used as described under pickles. If metal utensils, e.g. a sieve, must be used, the material should not be in contact with the metal for too long. Store in glass or earthenware containers.

Bottling of Chutneys and Sauces.—Bottles should be clean, dry and hot. The product should be bottled hot and sealed immediately. If corks are used, they should be boiled up in water and then covered with a circle of grease-proof paper before being placed on the jar. The seal may then be dipped into melted paraffin wax to make the bottle air-tight. If metal-capped jars are used, a layer of melted paraffin wax should be poured on to the product before sealing the bottles. Store in a very dry place. Allow to ripen before using.

Dried-Fruit Chutney.

1 lb. dried peaches;	2 c. sugar;
1 lb. dried apricots;	8 c. vinegar;
1 lb. stoned dates;	1½ T. salt;
1 lb. seeded raisins;	½ t. cayenne pepper;
½ clove of garlic;	½ t. cinnamon.

1. Soak the peaches and apricots in enough water to cover, and leave for at least two hours.

2. Put through the mincing machine together with the dates. Cook until tender in the water in which the fruit has been soaked.

3. Add the other ingredients and cook slowly for about two hours, or until of the right consistency, stirring occasionally.

Mango Chutney.

6 lb. underripe mangoes;
2 pints vinegar;
1 t. ground ginger;
1 lb. brown sugar;
1 lb. dried apricots;
¼ lb. chopped almonds;
1 oz. dried chillies *or* 1 t. cayenne pepper;
2 ozs. crushed mustard seed;
4 sections garlic.

1. Peel and slice mangoes. Sprinkle with 1 T. salt, and put in the sun to dry partially.
2. Soak apricots for two hours and put through a mincer.
3. Mix all the ingredients and cook slowly until thick.
4. If desired, 2 ozs. sultanas may be added.

Tomato Chutney.

2 lb. peeled tomatoes;
½ lb. brown sugar;
1 pint vinegar;
½ lb. sultanas;
2 sliced onions;
1 T. ground ginger;
1 T. salt;
Pinch of cayenne pepper;
2 ozs. crushed mustard seed;
4 sections garlic.

Mix all the ingredients, and boil gently, stirring occasionally, until the tomatoes are soft and the mixture has the right consistency.

Sauces.

A good sauce should be fine in flavour (whatever the flavour may be), and smooth to the palate. To obtain this result, slow and long cooking is essential. It is in most cases necessary to put the materials through a sieve. A sauce should have the consistency of thick cream. The predominating flavour should be that of the principal fruit or vegetable used, spices being added merely to impart flavour and not to remove the natural taste of the vegetables or fruit. Tomato sauce made of fairly ripe tomatoes, with spices added, is one of the most appetizing sauces.

Tomato Sauce.

20 ripe tomatoes;
2 small onions;
1 T. salt;
3 green sweet peppers;
A piece of stick cinnamon.
2 t. ginger (bruised);
2 t. cloves (whole);
¾ c. vinegar;
¾ c. sugar;

1. Remove the skins of the tomatoes by dipping them first into boiling water for a few seconds, and then into cold water.
2. Peel and chop onions.
3. Remove seeds from the peppers, and chop fine. Add to the cut up tomatoes and onions, and cook gently until tender.
4. Rub through a sieve, return to saucepan, and add vinegar, salt, sugar and spices tied in a muslin bag. Cook for 15 to 20 min. or until thick enough.

Apple Ketchup.

1 quart sieved apple pulp;
1 c. sugar;
1 t. pepper;
1 t. ground cloves;
1 t. dry mustard;
2 t. cinnamon;
1 T. salt;
2 onions (minced);
2 cups vinegar.

1. Combine all the ingredients, and mix well.
2. Bring to the boil and simmer for one hour.
3. Fill boiling hot into hot sterilized containers. Seal.

Chilli Sauce.

1 gal. ripe chopped tomatoes;	½ c. brown sugar;
½ c. chopped onions;	5 T. salt;
½ c. chopped sweet green peppers;	2 T. ginger;
½ c. chopped sweet red peppers;	1 T. mustard;
1 quart vinegar;	1 nutmeg, grated;
½ t. cayenne pepper;	1 T. cinnamon.

1. Peel tomatoes and onions. Chop onions and peppers fine.

2. Boil all the ingredients, except the vinegar, for two hours or until tender.

3. Rub through a sieve. Add vinegar and simmer for about one hour, stirring frequently when the mixture thickens.

REFERENCES.

Canning, Preserving and Jellymaking—Janet. M. Hill.
Home Canning—Taylor.
Foods and Cookery.
Delineator Cook Book.

Farm Planning:—

[*Continued from page* 47.

(6) *Marketing of Products.*—It is noted with pleasure that co-operative marketing has been making considerable progress lately. In this system only, will the farmer, especially the small farmer, find his salvation. Farmers have never found individualism profitable. By supporting the local co-operative bodies, the farmer can overcome most of his marketing difficulties. The aim should always be a farming enterprise closely related to co-operative marketing.

(7) *Self-sufficiency.*—Although this item is often overlooked, it is of great importance, economically especially, to make the enterprise self-sufficient in so far as this is possible. There are cases, for instance, where farmers have to travel miles to the nearest town to buy their butter, eggs, fruit, vegetables, etc. while they have the best opportunities for producing these requirements themselves on their own farms.

(8) *Obtaining Advice.*—All too often the advice of agricultural officers is called in only at the very last minute. The practical farmer is prepared for any contingency and keeps abreast of all aspects of crop cultivation, insect and disease control and all other matters important to a succesful enterprise. There are officers in the Department of Agriculture charged with the task of furnishing farmers with advice and information, and the farmers should regard these officers as friendly helpers.

Crops and Markets

A Statistical and Economic Review of South African Agriculture

by

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CONTENTS

Price Review for November, 1947.*

Fruit.—Avocados and guavas were scarce and prices on a high level. On the Johannesburg market the price for avocados increased from 5s. 11d. to 7s. 8d. per tray (National Mark). The supply of oranges and lemons was less than the demand. The markets were still well supplied with cold storage apples of inferior quality. There was a reasonable supply of deciduous fruit on all the markets.

Tomatoes.—All the markets were well supplied with tomatoes, but in many cases the quality was inferior. Prices decreased slightly, viz., from 5s. to 4s. 11d. per tray (National Mark No. 1) on the Johannesburg market and from 1s. 2d. to 1s. 1d. per tray on the Durban market, but increased from 2s. 8d. to 3s. 5d. per tray on the Cape Town market.

Onions.—Heavy Transvaal consignments dominated on nearly all the markets and prices decreased to a very large extent, e.g., from 27s. to 12s. 2d. per bag on the Johannesburg market for Transvaal onions and from 45s. 3d. to 13s. 4d. for Cape onions, and from 41s. 5d. to 15s. 6d. for Cape onions on the Cape Town market.

Potatoes.—Reasonable supplies of good quality reached all the markets. Prices increased from 22s. 3d. to 25s. per bag for Grade I on the Johannesburg market, from 21s. 8d. to 28s. 9d. for Grade I on the Durban market and from 27s. 10d. to 28s. 5d. for Grade I on the Cape Town market.

Vegetables.—The markets were generally well supplied with most kinds of vegetables, particularly during the second half of the month when more supplies of local origin became available.

Seeds, Grains and Feedstuffs.—There was a short supply of lucerne hay at the beginning of the month in Johannesburg and the

* All prices mentioned are averages.

price increased from 6s. 2d. to 6s. 7d. per bale for Transvaal lucerne. The supplies of teff hay were very small and the price increased from 4s. 7d. to 5s. 4d. per bale on the Johannesburg market.

Eggs and Poultry.—The demand for eggs was keen on all the markets. Supplies were, however, on a lower level. Prices increased from 1s. 8d. to 1s. 10d. per dozen for Grade I large eggs on the Johannesburg market and from 1s. 10d. to 2s. 1d. on the Durban market. There was a brisk demand for fowls. Ducks and turkeys were scarce. Prices increased from 6s. 3d. to 6s. 7d. (for live fowls) on the Durban market and from 6s. 2d. to 6s. 7d. on the Cape Town market, but decreased from 7s. 7d. to 6s. 5d. on the Johannesburg market.

Review of Wool Market.

DURING the month of November 104,315 bales of the new season's wool were offered for sale at auctions and the percentage sold, varied from about 75 to 85 per cent., while the bulk of the offerings not sold at auctions, were disposed of out of hand after each sale. Competition was keen for all types of wool but particularly for all long and short seed-free grassveld wools. Prices increased and has been above the levels recorded for the previous month with a slight relapse in values towards the end of the month.

Agricultural Conditions in the Union during November, 1947.

Weather Conditions.—Good showers occurred generally in the Union during November, excepting in the northern and western Transvaal, where the drought conditions were still severe. In several parts damage was caused by hailstorms. The number of drought-stricken districts totalled 59 in the Cape Province, 2 in Natal, 5 in the Transvaal and 23 in the Orange Free State.

Crops.—Ploughing and planting of summer crops was in full operation, particularly in those areas which had received sufficient rains. Cutworms, however, caused a certain amount of damage to young maize plants. The prospects for a fair fruit crop in the western Cape Province were satisfactory. In Natal the prospects for a good sugar cane crop improved.

Stock and Pastures.—The position of stock and pastures improved satisfactorily as a result of the rains which occurred. Stock diseases were quiet although lumpy skin disease occurred in various parts, while nagana caused some stock losses in Natal. Cases of heartwater were reported in the south-eastern Cape Province.

Fruit Crop Estimate.

(Western Province Fruit Research Station.)

EXTREMELY hot weather was experienced during November, while the coastal areas received very little rain. Reasonable precipitations nevertheless fell in the interior areas, and irrigation will consequently be much furthered. The hot weather has hastened the maturity of early fruit such as apricots and early peaches.

The apricot crop has been uncertain but in the case of peaches and prunes, larger crops than last year are expected. Only moderate

crops of pears and apples are expected. The prospects of a good grape crop appear to be particularly promising for both table and wine varieties.

Fruit diseases were conspicuously absent, and this year has seen the codling moth well under control, chiefly through the use of D.D.T. in the spraying programme.

Analysis of Sales of Eight Vegetable Varieties on Eight Most Important Municipal Markets in the Union.

By D. F. Marais.

IN the issue of *Crops and Markets* of November, 1946, particulars were given of the quantities and values of eight important vegetable varieties sold on the eight most important municipal markets in the Union, namely the municipal markets of Johannesburg, Pretoria, Bloemfontein, Cape Town, Port Elizabeth, East London, Durban and Pietermaritzburg. The eight vegetable varieties were—potatoes, onions, sweet potatoes, tomatoes, green beans, green peas, cabbages and cauliflowers.

The data were in respect of the years 1937 to 1945 and in the tables below the corresponding particulars for 1946 are now given.

The total yearly quantities and values of eight vegetable varieties, which were sold by public auction on the eight municipal markets in the Union, were as follows:—

Year.	1939.	1940.	1941.	1942.	1943.	1944.	1945.	1946.
Quantities sold ('000 tons).	180·5	182·2	194·4	230·8	274·3	214·7	243·8	282·1
Value (£'000)	1,020	1,507	2,194	2,491	3,008	3,269	3,800	4,139

It appears that the volume of sales in 1946 was higher than in 1945, and even higher than the peak reached in 1943. The increase in the value of the sales still continued in 1946 and exceeded the total value of 1945 by more than £300,000.

Quantities and Value of Each Vegetable Variety Sold on Eight Municipal Markets.

(*a*) *Quantities* (1,000 *lb.*).

Year.	Potatoes.	Onions.	Sweet Potatoes.	Toma-toes.	Green Beans.	Green Peas.	Cab-bages.	Cauli-flowers.
1939........	201,781	36,749	14,771	43,085	14,112	14,950	29,478	6,042
1940........	202,259	34,611	16,585	45,458	15,461	15,479	28,767	5,875
1941........	209,705	40,389	19,955	51,921	15,915	14,019	30,913	5,966
1942........	249,703	43,303	19,562	63,232	17,084	17,902	43,653	7,099
1943........	336,275	46,492	23,843	49,562	17,931	18,388	47,002	9,078
1944........	175,263	50,955	30,169	76,197	19,552	18,745	49,500	9,049
1945........	220,699	54,695	33,352	85,619	18,740	17,500	49,465	7,624
1946...... ..	274,671	54,365	32,177	90,365	20,069	18,010	63,353	11,251

(b) *Value* (£1,000).

Year.	Potatoes.	Onions.	Sweet Potatoes.	Tomatoes.	Green Beans.	Green Peas.	Cabbages.	Cauliflowers.
1939........	443·1	114·4	28·6	199·2	72·8	89·4	56·1	16·3
1940........	760·5	168·9	39·0	247·6	86·7	102·5	82·2	19·2
1941........	1,227·5	186·3	61·4	333·7	113·7	124·2	123·1	24·2
1942........	1,357·2	229·9	64·6	394·9	125·5	139·7	157·4	31·7
1943........	1,469·9	289·7	86·4	514·7	174·9	203·7	219·4	49·2
1944........	1,237·6	351·5	199·4	704·9	214·3	236·2	269·1	56·1
1945........	1,741·6	341·2	165·6	782·3	206·0	238·9	269·4	55·4
1946........	2,127·1	350·8	189·1	743·9	192·4	240·0	233·7	61·5

It appears from the above table that the quantities of tomatoes, green beans, cabbages and cauliflowers sold, still show a rising tendency reached a further peak in 1946. Although more potatoes were sold in 1946 than in the previous year, the total volume did not reach the peak of 1943. In comparison with 1945, less onions and sweet potatoes were marketed in 1946.

As regards the values, it appears that onions and sweet potatoes, notwithstanding smaller quantities, realized a higher total value in 1946 than in 1945. Tomatoes, green beans and cabbages again realized a lower total value in 1946 than in 1945 in spite of larger quantities, this decrease in the value of these vegetable varieties being probably due to the larger supply.

The value of potato sales reached the record peak of more than £2·1 million in 1946. It is nearly £660,000 more than the total value reached in 1943 by a considerably greater quantity of potatoes.

Cauliflowers and green peas showed a rise in value as well as in quantities.

Quantities and Value of Eight Vegetable Varieties Sold on Each of the Eight Municipal Markets.

(a) *Quantities Sold* (1,000 *Ton*).

Year.	Pretoria.	Johannesburg.	Bloemfontein.	Cape Town.	Port Elizabeth.	East London.	Durban.	Pietermaritzburg.
1937........	10·5	74·3	4·6	23·0	9·4	5·5	14·7	3·7
1938........	12·5	79·6	5·5	25·0	10·9	5·9	15·9	7·1
1939........	13·6	84·1	5·6	32·6	12·3	6·3	18·4	7·5
1940........	14·5	85·4	4·5	34·7	11·0	5·4	19·5	7·1
1941........	16·3	87·6	4·1	39·7	10·9	4·6	24·0	7·2
1942........	20·1	100·9	5·0	50·2	12·5	6·7	26·8	8·6
1943........	24·0	131·2	6·5	50·6	13·5	7·0	31·5	10·0
1944........	19·9	102·3	5·7	44·6	10·7	5·5	19·7	6·3
1945........	24·1	121·1	7·9	43·6	9·3	4·9	24·2	8·8
1946........	28·9	139·2	8·7	48·9	9·5	7·8	29·4	9·8

(b) *Value* (£1,000).

Year.	Pretoria.	Johannesburg.	Bloemfontein.	Cape Town.	Port Elizabeth.	East London.	Durban.	Pietermaritzburg.
1937........	77·7	559·2	34·8	179·6	68·6	35·9	107·0	30·2
1938........	79·2	505·7	36·5	176·0	72·5	37·5	107·2	44·3
1939........	74·2	454·8	32·7	198·5	71·8	37·7	107·1	43·0
1940........	119·9	692·4	37·4	301·4	91·2	40·1	166·4	58·0
1941........	186·6	992·6	45·6	447·7	122·9	51·2	268·4	79·2
1942........	214·2	1,074·7	52·1	564·5	133·3	61·4	297·0	93·5
1943........	264·6	1,421·9	70·4	577·5	150·5	78·3	333·0	111·8
1944........	291·3	1,532·4	88·4	687·2	154·8	79·8	330·1	105·1
1945........	377·2	1,850·7	120·0	693·2	152·1	91·5	378·8	136·9
1946........	410·6	2,002·8	123·0	741·6	141·7	98·1	466·8	154·0

It appears from the above table that on all the municipal markets the total quantities sold in 1946 were higher than in 1945. On the Pretoria market for example about 4,000 tons more were sold; on the Johannesburg market about 18,000 tons more and on the Durban market approximately 5,000 tons more. In the case of Johannesburg, Durban, Pretoria, Bloemfontein and East London even the record quantities of 1943 were surpassed.

Regarding the value of sales, new peaks were reached on all markets in 1946, excepting Port Elizabeth.

Index of Prices of Field Crops and Animal Products.

THIS index, as shown elsewhere in this issue, increased from 218 to 225 in November, 1947.

The most important changes occurred in the following groups:—

(*a*) "Winter Cereals" increased from 210 to 212, due to an increase in the price of wheat for the 1947/48 season.

(*b*) "Hay" increased from 151 to 169 as a result of increases in the prices of lucerne and teff hay.

(*c*) "Pastoral Products" increased from 221 to 242 due to an increase in wool prices.

(*d*) "Dairy Products" decreased from 261 to 214, because the payment of seasonal premiums had been discontinued as from 1 November 1947.

(*e*) "Slaughter Stock" increased from 210 to 216 owing to the seasonal increase in the price of slaughter cattle in the controlled areas.

(*f*) "Poultry and Poultry Products" increased from 176 to 184 due to the increase in the price of eggs.

Index of Prices of Field Crops and Animal Products.

(Basic period 1936-37 to 1938-39 = 100.)

SEASON (1 July to 30 June).	Summer cereals. (*a*)	Winter cereals. (*b*)	Hay. (*c*)	Other field crops. (*d*)	Pastoral products. (*e*)	Dairy products. (*f*)	Slaughter stock. (*g*)	Poultry and poultry products. (*h*)	Combined index.
WEIGHTS.	19	13	2	3	34	6	17	6	100
1938–39	92	109	96	89	79	102	106	94	93
1939–40	86	114	77	95	115	105	106	89	104
1940–41	108	120	106	156	102	108	110	103	109
1941–42	120	144	143	203	102	131	135	136	124
1942–43	160	157	144	159	122	147	168	167	147
1943–44	170	186	137	212	122	154	185	188	159
1944–45	183	186	160	281	122	177	179	184	164
1945–46	201	194	164	312	118	198	185	170	170
1946–47	241	209	149	232	169	205	192	204	198
1946—									
July	245	194	182	303	120	231	183	193	182
August	242	194	181	319	120	231	188	164	181
September	243	194	183	351	163	231	196	156	198
October	240	194	166	365	171	231	204	155	201
November	240	210	165	309	179	194	208	171	204
December	242	210	157	236	168	194	208	201	200
1947—									
January	242	210	144	174	178	194	200	238	202
February	240	210	127	157	187	194	191	248	203
March	240	210	154	158	189	194	182	251	203
April	239	210	176	169	190	194	179	283	205
May	225	210	166	187	192	194	183	318	206
June	225	210	169	213	174	247	186	291	203
July	224	210	184	216	175	261	191	207	200
August	225	210	184	213	176	261	196	188	200
September	226	210	184	229	228	261	200	169	218
October	227	210	151	265	221	261	210	176	218
November	226	212	169	266	242	214	216	184	225

(*a*) Maize and kaffircorn.
(*b*) Wheat, oats and rye.
(*c*) Lucerne and teff hay.
(*d*) Potatoes, sweet potatoes, onions and dried beans.
(*e*) Wool, mohair, hides and skins.
(*f*) Butterfat, cheese milk and condensing milk.
(*g*) Cattle, sheep and pigs.
(*h*) Fowls, turkeys and eggs.

Prices of Bananas and Pineapples on Municipal Markets.

Season.	Bananas (Per Crate) (a)			Pineapples. (b)						
	Cape Town.	Johannesburg.	Pretoria.	Cape Town. Box.	Durban. Doz.	Johannesburg. Ordinary. Doz.	Johannesburg. Queens and Giants. Doz.	Port Elizabeth. Box.	East London. Doz. Large.	Bloemfontein. Bushel Box.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1938-39	22 5	9 10	16 5	5 4	3 3	1 1	—	3 5	1 2	4 10
1939-40	24 4	8 7	15 10	6 1	3 10	1 4	4 8	3 10	1 5	4 9
1940-41	27 0	7 2	14 3	5 10	2 8	1 5	2 1	4 5	1 5	5 10
1941-42	28 6	7 6	14 6	6 6	3 0	1 7	2 5	4 6	1 8	6 2
1942-43	30 0	11 9	22 7	7 4	3 0	1 8	3 10	4 11	2 1	7 3
1943-44	37 8	13 2	18 10	8 3	3 6	2 4	2 1	6 3	2 10	8 4
1944-45	38 10	13 0	15 3	10 4	3 9	2 6	3 9	7 3	3 3	8 6
1945-46	67 0	20 1	28 7	10 4	4 7	4 1	4 8	8 11	3 11	10 7
1946—										
July	60 11	25 4	25 8	15 7	3 2	9 3	10 3	15 5	5 7	13 5
August	72 1	23 9	31 5	19 10	4 10	7 11	9 7	16 10	4 7	13 10
September	66 5	20 6	30 8	10 1	7 7	6 5	7 2	12 2	4 7	13 11
October	78 10	28 6	34 6	15 5	6 5	6 9	6 5	13 10	4 3	14 5
November	63 8	47 10	32 4	14 10	8 11	6 3	5 4	13 10	4 6	15 11
December	67 7	30 7	35 4	16 5	4 5	7 0	—	11 11	4 7	17 8
1947—										
January	41 7	20 2	20 4	9 2	5 1	2 3	3 6	6 8	3 6	7 5
February	46 0	14 10	15 10	6 10	2 0	2 0	2 7	5 4	3 7	6 8
March	47 5	18 4	22 10	9 3	—	3 6	—	8 3	5 2	11 8
April	57 2	24 8	23 8	12 9	—	4 5	—	9 5	4 1	13 10
May	62 0	20 1	26 8	7 11	—	4 3	—	8 2	4 4	9 6
June	32 7	19 6	23 11	9 3	—	3 8	—	6 11	2 11	9 6
July	55 1	17 6	33 4	7 3	—	4 3	—	7 5	3 7	8 7
August	44 6	20 4	16 9	8 5	7 2	5 2	—	9 9	3 1	9 11
September	55 8	21 10	21 7	9 10	—	4 5	—	8 0	3 7	8 4
October	57 7	20 2	25 7	10 10	8 3	5 0	—	11 5	3 8	10 9
November	60 5	18 2	20 8	12 7	11 2	8 2	—	17 10	5 6	12 6

(a) Season 1 January to 31 December.
(b) Season 1 October to 30 September.

Average Prices of Onions and Sweet Potatoes on Municipal Markets.

Season (1 July to 30 June).	Onions (120 lb.). Johannesburg.		Cape Town.	Pretoria.	Durban.		Sweet Potatoes. (120 lb.).		
	Transvaal.	Cape.	Cape.	Cape.	Local.	Cape.	Johannesburg. Table.	Durban.	Cape Town.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1938-39	8 3	8 10	7 4	7 10	8 6	9 6	5 7	4 8	5 3
1939-40	6 3	9 10	7 3	9 11	9 8	10 5	5 7	5 9	5 0
1940-41	12 5	12 3	9 10	11 11	11 2	12 7	7 3	6 4	5 5
1941-42	10 5	13 11	10 4	13 10	13 0	14 3	9 10	7 1	8 4
1942-43	13 8	14 0	12 6	14 7	12 9	14 5	9 8	8 1	8 5
1943-44	16 2	18 9	15 1	17 4	19 1	19 2	12 0	10 9	10 7
1944-45	14 3	18 5	15 0	18 1	18 8	19 5	17 3	15 1	16 3
1945-46	12 4	14 11	12 9	15 3	14 9	15 7	14 11	13 5	14 7
1946-47	21 0	19 0	17 4	19 3	23 2	20 0	16 3	14 6	16 11
1946—									
July	11 10	14 3	12 0	15 0	15 2	15 6	15 2	15 2	17 4
August	14 9	17 0	13 7	15 10	20 6	18 7	16 10	16 0	18 8
September	20 9	25 3	20 4	23 2	21 5	23 3	20 0	16 5	22 11
October	24 9	28 1	32 5	24 0	32 3	31 8	24 6	16 9	20 10
November	21 11	—	26 11	—	24 8	21 1	23 10	15 1	20 8
December	16 8	15 2	12 4	—	19 8	19 6	18 11	11 11	25 5
1947—									
January	14 9	14 0	11 5	14 10	15 6	14 3	16 6	9 6	19 8
February	14 8	14 5	11 9	13 7	16 1	17 8	16 11	7 6	18 11
March	17 6	18 7	14 3	20 3	13 4	17 6	15 6	13 4	16 1
April	20 7	22 2	17 10	22 3	24 11	24 4	12 7	8 4	10 9
May	22 4	24 11	20 11	26 2	27 5	24 1	10 1	8 6	11 7
June	26 2	26 9	23 3	26 9	26 4	27 2	9 9	7 5	11 5
July	31 5	31 5	25 2	30 6	29 10	34 5	8 6	7 10	10 9
August	22 5	42 8	40 2	43 9	37 8	42 11	8 2	6 5	8 1
September	43 1	50 10	45 10	46 2	50 11	52 0	8 1	5 11	11 7
October	27 0	45 3	41 5	—	31 9	71 3	9 5	7 5	10 7
November	12 2	13 4	15 6	—	17 5	13 0	11 3	7 7	12 0

Average Prices of Cabbages, Cauliflower and Tomatoes on Municipal Markets.

Season (1 July to 30 June).	Cabbages (Bag). (a)			Cauliflower (Bag). (a)			Tomatoes (Trays 15 lb.).			
							Johannesburg.			
	Johannesburg.	Cape Town.	Durban.	Johannesburg.	Cape Town.	Durban.	N.M. No. 1.	Other.	Cape Town.	Durban.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1938–39	3 10	3 0	3 10	3 0	1 8	3 5	2 2	1 3	1 8	0 10
1940–41	5 10	4 8	7 1	3 11	4 3	5 3	2 7	1 6	2 1	1 2
1941–42	8 10	5 5	11 5	5 9	5 7	7 11	3 1	1 9	2 3	1 6
1942–43	5 6	5 11	9 1	5 0	5 9	7 6	3 4	1 10	2 1	2 7
1943–44	11 1	7 4	17 6	9 2	6 2	12 1	5 5	2 9	3 7	2 0
1944–45	9 7	6 11	13 5	7 5	6 6	9 8	4 1	2 0	2 10	1 9
1945–46	10 1	7 1	10 11	8 4	6 5	11 1	4 11	2 4	3 4	1 7
1946–47	6 7	6 4	10 6	8 4	11 2	10 5	4 3	2 5	2 8	2 5
1946—										
July	7 11	1 10	9 9	8 6	—	11 3	2 2	1 1	2 3	1 0
August	5 9	2 1	7 1	8 9	3 2	11 1	2 5	1 3	1 11	0 9
September	4 11	2 5	5 8	9 6	4 0	13 7	3 2	1 9	2 2	1 1
October	5 6	8 0	7 0	15 10	13 7	12 0	4 5	1 9	2 8	0 11
November	5 7	11 5	12 0	13 4	15 1	—	5 2	2 1	3 4	1 1
December	8 9	9 11	11 11	11 10	—	—	4 8	1 11	3 0	1 10
1947—										
January	9 0	12 3	5 9	11 3	23 8	—	5 0	2 0	2 11	1 6
February	11 4	14 10	14 3	12 5	15 2	—	5 6	2 3	3 4	3 1
March	12 0	17 2	17 6	12 1	16 6	31 5	7 10	3 9	4 0	2 9
April	7 1	14 9	16 0	6 2	14 2	11 9	6 2	2 9	3 8	2 3
May	6 8	10 4	12 1	7 0	9 9	9 5	7 4	3 8	2 10	2 5
June	6 1	8 3	8 6	8 5	8 8	9 0	5 2	2 5	4 4	1 11
July	6 0	6 9	7 0	7 4	7 6	9 10	3 8	1 8	2 3	1 9
August	4 1	7 3	5 5	5 1	10 3	5 5	3 10	1 11	2 9	1 3
September	4 5	7 0	4 4	9 1	10 0	5 9	7 2	3 9	4 1	1 3
Oktober	5 5	7 0	4 7	16 9	16 2	—	5 0	1 10	2 8	1 2
Nover ber	4 8	5 2	6 4	6 11	11 3	—	4 11	1 11	3 5	1 1

(a) Weights of bags vary, but on the average are approximately as follows: For cabbages—Johannesburg, 150 lb.; Cape Town, 105 lb.; and Durban, 90 lb. For cauliflower—Johannesburg, 100 lb.; Cape Town, 65 lb. and Durban, 85 lb.

Prices of Avocados and Papaws on Municipal Markets.

Season	Avocados (Per Tray). (a)				Papaws. (b)					
	Cape Town.	Durban.	Johannesburg.		Cape Town Std. Box.	Durban. Tray.	Johannesburg.		Port Elizabeth Std. Box.	Bloemfontein Std. Box.
			Ordinary.	N.M.			Ordinary Std. Box.	N.M. Std. Box.		
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1938–39	1 6	0 11	1 3	1 11	2 0	0 10	1 7	2 0	2 0	1 8
1939–40	2 1	1 2	1 9	2 11	2 3	0 10	1 4	1 9	1 11	1 6
1940–41	1 10	0 10	1 5	2 4	2 1	1 1	1 9	2 2	2 3	1 9
1941–42	2 4	1 7	2 1	3 4	2 5	0 10	1 10	2 1	1 11	2 0
1942–43	3 1	1 8	2 10	4 3	3 2	1 2	2 1	2 7	2 2	2 0
1943–44	4 1	1 6	3 7	5 2	3 2	1 5	2 5	3 5	3 3	2 7
1944–45	2 8	1 8	3 0	5 10	3 4	1 6	3 1	4 1	3 5	3 0
1945–46	3 8	2 5	3 11	5 10	3 6	1 6	3 6	4 5	3 7	3 3
1946–47	—	—	—	—	3 2	1 6	3 2	4 8	3 3	2 9
1946—										
July	4 1	1 9	5 6	6 3	4 11	2 7	5 4	6 0	6 3	4 11
August	5 7	5 1	5 10	6 8	5 1	2 6	4 4	5 1	4 9	4 4
September	9 3	—	6 5	5 8	2 10	1 6	2 8	3 2	2 3	2 11
October	8 8	4 7	5 11	6 7	2 5	1 4	1 9	2 4	2 2	1 10
November	8 6	3 6	6 3	7 4	2 8	0 8	2 3	2 11	2 11	2 8
December	8 9	2 0	5 11	8 3	3 7	1 9	3 7	4 8	4 11	2 6
1947—										
January	7 11	—	5 5	—	4 6	1 8	4 10	6 6	8 0	3 9
February	2 6	—	2 11	—	4 9	1 5	7 10	—	8 11	—
March	2 0	2 1	2 11	3 11	6 5	3 10	8 2	8 1	—	3 5
April	2 7	1 2	2 7	3 6	6 4	1 6	6 0	6 9	7 2	4 7
May	2 2	1 2	3 6	4 9	3 7	2 0	3 10	5 2	4 1	3 3
June	2 8	1 4	3 9	4 5	3 2	1 8	3 10	4 5	3 9	3 3
July	3 8	1 5	4 5	5 11	3 6	1 11	3 2	4 0	3 0	3 2
August	5 0	2 2	5 2	5 11	2 11	1 3	2 7	3 1	2 9	3 0
September	5 6	3 6	4 11	5 5	2 0	1 0	2 4	2 8	2 0	2 5
October	6 0	—	5 1	5 11	2 6	1 0	2 3	3 1	3 2	2 9
November	5 9	—	5 4	7 8	3 1	1 3	2 5	3 1	3 1	2 7

(a) Season 1 January to 31 December.
(b) Season 1 April to 31 March.

Average Prices of Green Beans, Green Peas and Carrots on Municipal Markets.

SEASON (1 July to 30 June.)	GREEN BEANS (Pocket 20 lb.).			GREEN PEAS (Pocket 20 lb.).			CARROTS (Bag). (a)		
	Johannesburg.	Cape Town.	Durban.	Johannesburg.	Cape Town.	Durban.	Johannesburg.	Cape Town.	Durban
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1938-39	1 8	2 3	2 0	2 4	1 9	1 2	3 8	2 6	6 1
1940-41	1 11	2 9	1 5	2 8	2 4	2 3	5 9	4 11	13 4
1941-42	2 7	3 10	2 6	3 11	3 3	3 4	8 5	8 11	17 2
1942-43	3 1	4 3	3 0	3 3	2 10	3 9	5 1	8 9	13 2
1943-44	3 8	4 11	3 0	4 11	4 10	4 11	9 11	11 1	20 2
1944-45	3 7	5 1	4 1	4 9	4 1	5 5	8 3	9 11	19 10
1945-46	3 4	4 7	3 6	5 11	7 2	6 1	8 10	11 4	17 1
1946-47	3 11	3 7	3 6	4 10	4 3	5 0	5 9	4 9	14 11
1946—									
July	3 2	1 11	2 2	2 7	3 6	3 4	3 8	4 8	7 10
August	6 3	4 2	6 6	5 10	5 0	4 9	4 5	3 8	11 0
September	6 6	7 5	6 4	5 0	4 11	5 1	3 8	3 2	10 11
October	5 0	5 0	5 2	3 3	3 6	5 7	4 7	4 1	9 7
November	2 11	2 7	1 11	6 5	3 10	9 5	6 3	3 7	11 5
December	3 9	2 8	2 5	9 0	—	7 0	7 6	5 4	19 5
1947—									
January	3 0	—	3 5	4 0	8 7	4 9	7 7	—	16 5
February	4 2	—	5 1	3 2	—	5 8	10 4	—	12 8
March	3 5	—	2 8	5 3	—	7 5	16 8	20 0	24 5
April	2 7	2 5	2 1	6 7	5 1	7 8	13 4	4 11	27 1
May	3 0	3 3	2 5	9 0	4 0	4 8	8 10	18 8	23 8
June	2 11	3 4	4 3	5 9	4 4	3 7	7 1	17 11	16 7
July	6 0	4 6	5 2	5 8	5 5	4 11	6 0	11 7	15 11
August	10 2	9 1	8 0	5 0	3 8	3 4	9 3	7 7	13 7
September	3 9	5 4	2 8	3 6	3 0	2 10	6 4	7 0	9 0
October	2 9	2 6	1 9	4 11	2 11	3 9	7 7	7 7	11 5
November	3 0	1 9	4 6	6 5	4 8	5 0	9 9	5 10	11 6

(a) Weights of bags v y, but on the average are approximately as follows:—Johannesburg, 130 lb. Town, 90 lb.; and Durl n, 120 lb.

Average Prices of Lucerne, Teff, Kaffircorn and Dry Beans.

SEASON AND MONTH (b)	LUCERNE (per 100 lb.).			Teff Johannesburg (a) 100 lb.	KAFFIRCORN in bags (200 lb.).		DRY BEANS (200 lb.) bags.		
	Johannesburg (a).		Cape Town 1st grade.		F.o.r. producers' stations.		Johannesburg (a).		
	Cape.	Transvaal.			K1.	K2.	Speckled Sugar.	Cow-peas.	Kidney.
	s. d.	s. d.	s. d.	s. d.	s. d.	s d.	s. d.	s d.	s. d.
1938-39	3 10	3 1	4 0	2 7	13 1	12 9	25 0	16 9	24 2
1939-40	3 0	2 5	3 4	2 6	8 8	9 4	21 11	13 11	21 2
1940-41	4 2	3 5	4 3	3 3	15 6	17 0	30 0	16 8	27 11
1941-42	5 7	5 2	5 8	4 7	18 10	19 6	32 10	19 8	28 3
1942-43	5 5	6 0	7 4	5 5	24 10	24 10	34 0	25 8	24 2
1943-44	5 4	5 6	7 3	4 5	21 0	21 7	49 6	29 11	32 1
1944-45	6 4	5 4	7 2	4 9	18 8	18 8	88 7	39 6	70 6
1945-46	6 6	5 11	7 7	4 8	24 8	24 8	101 0	62 10	82 8
1946-47	5 11	5 7	7 5	4 3	45 9	45 9	78 11	42 9	61 9
1946—									
July	7 5	6 9	7 3	4 5	57 10	57 10	81 8	45 1	67 7
August	7 5	4 8	7 3	4 3	48 5	48 5	69 11	41 1	61 7
September	7 6	7 0	7 3	4 4	50 0	50 0	73 0	40 4	61 11
October	6 9	4 11	6 9	4 1	40 3	40 3	69 2	34 5	56 6
November	6 9	5 10	7 2	3 11	40 10	40 10	61 4	35 3	59 10
December	6 3	5 6	7 3	4 5	48 8	48 8	70 2	36 6	52 11
1947—									
January	5 10	5 11	7 5	3 8	48 9	48 9	61 4	38 11	51 4
February	5 0	4 10	7 5	3 11	40 11	40 11	44 3	33 6	44 3
March	6 3	5 10	7 5	3 11	40 8	40 8	47 1	35 1	49 3
April	7 1	6 10	7 8	4 7	38 4	38 4	55 7	42 3	56 1
May	6 8	7 6	7 9	4 6	33 5	33 5	50 8	38 2	50 0
June	6 9	6 9	8 3	4 7	33 0	33 0	50 4	41 2	49 [illegible]
July	7 4	7 1	6 9	5 1	30 5	30 5	45 9	38 7	48 9
August	7 4	6 5	8 4	5 2	32 7	32 7	52 4	43 0	49 2
September	7 5	—	7 8	4 10	38 2	38 2	52 10	46 7	53 9
October	5 11	6 2	7 8	4 7	38 11	38 11	51 0	45 6	50 9
November	6 7	6 7	6 3	5 4	37 5	37 5	56 0	47 3	58 2

(a) Municipal Market.
(b) Seasonal year for kaffircorn. 1 June–31 May. Dry Beans, 1 April–31 March; Lucerne and teff, 1 July–30 June.

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[*Photo on Cover:* Boland Harness Horses.]

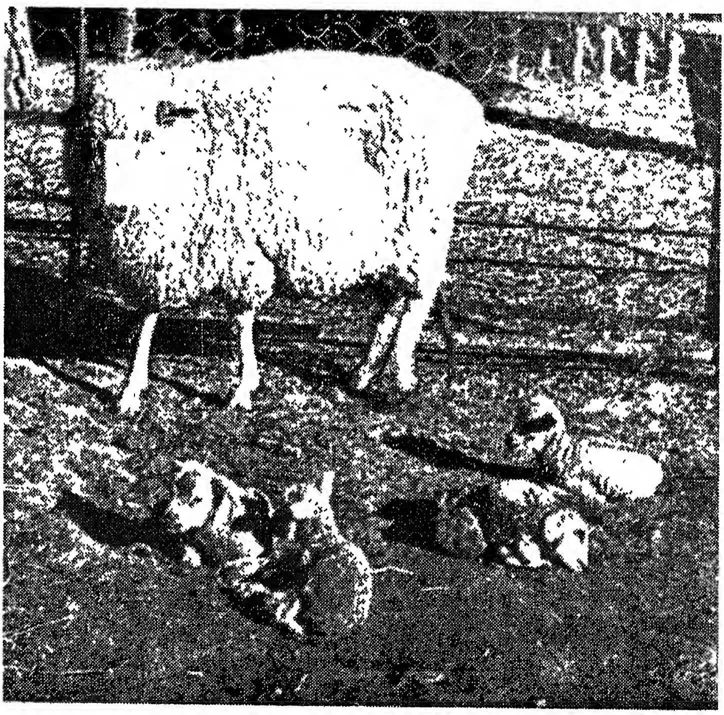
[NOTE.—Articles from *Farming in South Africa* may be published provided acknowledgment of source is given.]

G.P.-S.9702—1947-8—8.500.

A Ewe with Quadruplet Lambs.

AT the Grootfontein College of Agriculture, Middelburg, C.P., an experiment is being conducted in which fatlambs are being bred on a closed unit 7⅓ morgen in extent and completely under irrigation. In winter the ewes are kept on wheat grazing and during summer on lucerne grazing with a view to enabling the lambs born on this plot to attain a live weight of 60 lb. within 90 to 120 days.

On such valuable grazing, fertility is very important. The different breeds of sheep vary in regard to fertility and for that reason the following half-breed types of ewes are being tested out, viz. Dorset Horn × Merino; Border Leicester × Merino and Romney Marsh × Merino. These types are very fertile, and high fertility is assured because grazing conditions are always prime.



A Border Leicester × merino ewe with 4 lambs. Grootfontein College of Agriculture, Middelburg, C.P.

Among the Border Leicester × Merino ewes which, during a period of three years produced an average of 131 per cent. of lambs for slaughter, there was one ewe during this year (accompanying illustration) which gave birth to quadruplet lambs, three of which were alive at birth. Their weight at birth was 6 lb. each.

This is an exceptionally fertile ewe, certainly above the average for the type. She is 8 years old and since July, 1942, has produced 12 lambs.

(Dr. L. L. Roux, Grootfontein College of Agriculture.)

FARMING IN SOUTH ... AFRICA

VOL. 23 FEBRUARY 1948 No. 263

Editorial :

Mechanization for Increased Production.

THIS summer season may be regarded as being somewhat above normal for stock and grain farmers in most parts of the summer-rainfall areas of the Union. In the circumstances, prospects for, *inter alia*, a reasonably large mealie crop in comparison with that of previous years are good. A large annual mealie crop is of primary importance to human and animal nutrition, and also to the country's national economy. The state is, however, confronted with several problems; first, what average level of production will the South African farmer be able to maintain in the future; secondly, to what maximum level could production be raised especially as regards the principal foodstuffs if due regard were had to our soil and natural factors; and thirdly, what measures could be taken by producers to promote a greater degree of stability, especially in respect of grain production.

To supply the answers to the above it would be well to examine the primary factors of production under normal rainfall conditions. Amongst these can be mentioned proper soil cultivation in the broader sense; phosphatic fertilization; timely planting of crops; the use of varieties best suited to the particular environment according to the planting-season; the control of pests, and weed control. Of all these factors, effective weed control should be regarded as the most important simple limiting factor in agricultural production in South Africa. If this single factor could be kept under control, agricultural production could be raised to a considerably higher level, the production on those very arable lands appreciably increased and a higher production obtained per morgen.

It would definitely be wrong to assume that most farmers are not familiar with the production factors mentioned and with their means of control. Nevertheless, the farmer, in endeavouring to control weeds, is often compelled to fight an unequal battle, because of the general ineffectiveness of his tractive power and the unsuitability of many of the agricultural implements at his disposal. Weeds must be thoroughly eradicated in good time when still in the early, vulnerable stage. In the large-scale production enterprises of to-day, and with the present labour shortage, draught oxen are no longer suitable. Being so slow, the ox usually makes crop cultivation enterprise too vulnerable to permit of optimum efficiency under present-day conditions in most of our cropping areas. Successful weed control can best be effected by the use of mechanical tractive power and efficient rapid-moving implements. With these he can, for example, perform within one week the hoeing which would otherwise take a month, and still save on manpower as well. He is therefore in a position to destroy weeds in their most vulnerable stage—a process which can be repeated again and again during the season.

As proof of the beneficial effects on production, of effective weed control, results of experiments can be quoted, conducted at the Potchefstroom College of Agriculture, where an average mealie crop of 14 bags per morgen was harvested over a period of 25 years without fertilization, and 20 bags per morgen over the same period with phosphatic fertilization. As against this, the average mealie production of neighbouring farmers was only approximately 4 bags per morgen, i.e. 3 to 4 times as low as that obtained from the crop which received least treatment. This noteworthy difference must be attributed entirely to proper and timely weed control. Furthermore, it also proves that, even in a less favourable production area, e.g. the western Transvaal, the mealie crop could be at least trebled by effective control simply by taking production factors into proper consideration.

Thus, unless the South African Farmer acquires the equipment to enable him to gain the upperhand over this factor of production in particular, average production per morgen of most crops will remain alarmingly low—and as long as this is the case, our annual production, especially that of mealies and other summer-cereal crops, will be a constant source of anxiety to the nation. There is no doubt about the fact that the average yield of summer crops could easily be increased by proper weed control. By giving this single factor its due attention, the mealie yield of the Union could be doubled without any extension of the present area under cultivation.

It is, therefore, strongly felt that our farmers should pay more attention to thorough soil cultivation and weed control, with a view to ensuring maximum crops. Every farmer should decide for himself how this could be most economically achieved. Some would be well advised to cultivate an even smaller morgenage than at present, since it is better to cultivate 100 morgen thoroughly and judiciously than to cultivate, say, 200 morgen, and obtain less than half the yield which would be obtained with clean cultivation.

But with the present labour shortage and the steadily decreasing pasturage, mechanized equipment would afford the best solution to the problem. Consequently, farming operations are rapidly being mechanized on our farms and, but for the serious shortage of farm-tractors, mechanization would have been an even more prominent feature in our present-day farming systems. But the auspices for improvement are good and in view of the extreme importance of increasing our yield per morgen, farmers should carefully consider the desirability of increasing mechanization on farms.

Supply of Tobacco Seed by the Department.

D. F. Retief, Officer in Charge, Rustenburg Agricultural Research Station.

THE Department of Agriculture has decided to continue with the production of seed of all varieties of tobacco for sale to *bona fide* farmers as has been the case in the past. As from 1 January 1948, however, the price of tobacco seed has been increased from 1s. to 1s. 6d. per ounce. The old price of 2s. 6d. per ounce charged for orders from outside the Union of South Africa and the High Commission territories remains.

 [*Continued on page* 129.

The Blackhead Persian.

F. J. Labuschagne, Professional Officer (Sheep and Wool), Grootfontein College of Agriculture, Middelburg, C.P.

OF all the different breeds of sheep, none probably presents a more picturesque sight than a flock of well-bred Blackhead Persians. Attention is immediately aroused by the striking contrast between the pitch-black heads and snow-white bodies, and also by the remarkable uniformity of appearance. The splendour of this spectacle is further enhanced by the somewhat wild but proud carriage which immediately creates an impression of hardiness.

The Blackhead Persian [a member of the fat crossbreeds indigenous to North Africa (Somaliland) and Asia Minor (Arabia)] is a mutton sheep, its fleece having no commercial value.

Actually the term "Persian" employed in South Africa is a misnomer, since this breed is not indigenous to Persia. Presumably the name owes its origin to the fact that the first of these sheep to come into this country were shipped as slaughter stock from the Persian Gulf.

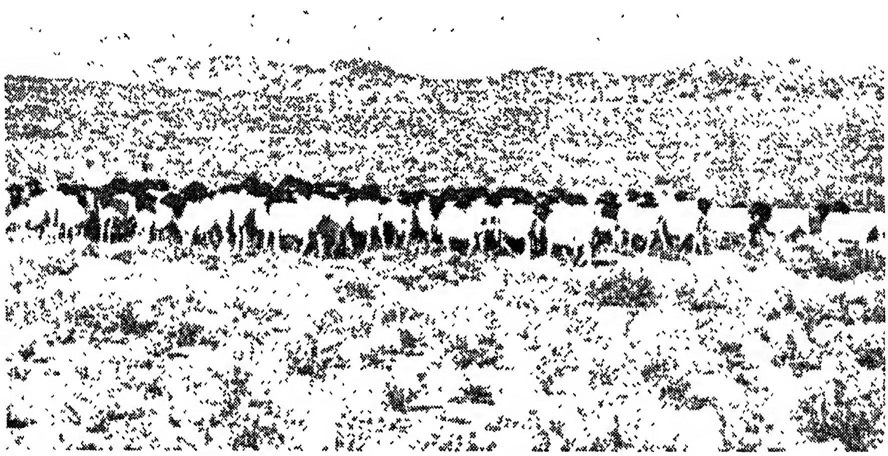


FIG. 1.—A beautiful flock of Blackhead-Persian sheep at Grootfontein.

The late Mr. S. M. Gadd, Springfield, Tafelberg, Middleburg, C.P., supplied the following interesting historical sketch of the Blackhead-Persian sheep in South Africa.

About the year 1870 a disabled sailing vessel touched at Fort Beaufort on the Swellendam coast. On board there were, *inter alia*, a ram and three ewes of the blackhead breed, shipped from the Persian Gulf for slaughtering purposes. The late Honourable, Messrs. Barry and Heatlie visiting the vessel, were very much impressed with the appearance of these unfamiliar and peculiar sheep which they saw on board. Approaching the captain with a view to buying the sheep they succeeded in obtaining possession of them in exchange for other slaughter stock.

The four Blackhead-Persian sheep were taken on board another vessel and shipped to Cape Town, and then railed to Wellington whence they were conveyed by ox-wagon to the farm Glen Heatlie.

Soon after their arrival on the farm, one of the ewes was gored to death by a bull. Another ewe however, gave birth to a twin—a ram and a ewe. The ewe lamb had a brown instead of a black

head and so too, her progeny. The flock was later moved to the farm Angora, but finally returned to Glen Heatlie.

The first Blackhead-Persian sheep to gain entry to the eastern Cape Province were a ram and a ewe sold to the late Mr. Hockly of Cullendale, Bedford.

About 1894 the late Mr. John E. Wood of Grahamstown, who was keenly interested in this sheep breed, bought Mr. Heatlie's stud flock of 34 ewes and one ram and sent them to Mr. S. M. Gadd, Springfield, Tafelberg, Middelburg, C.P., where they remained on shares for six years, growing during this period to a flock of more than 500 sheep.

The late Mr. Wood also farmed with Blackhead Persians for a number of years on his farm Krantzplaats in the Cradock district. After his death, Blackhead-Persian ewes were sold for as much as £8. 12s. 6d. each, a high price for sheep in those days.

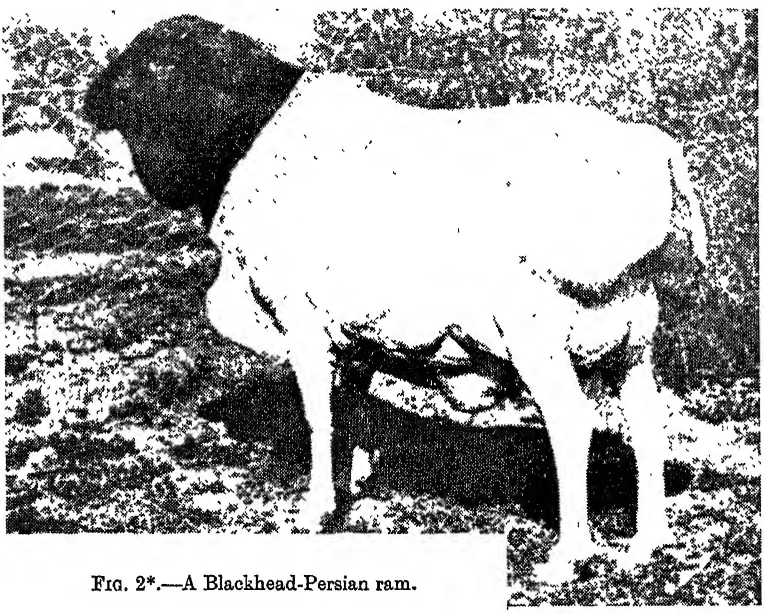


Fig. 2*.—A Blackhead-Persian ram.

This breed soon became famed in this country for its numerous good characteristics, such as hardiness, prolificacy, etc., and to-day these animals are to be found throughout the Union and even in Rhodesia.

After 1900, Messrs. Barry Bros., of Robertson, made several other importations, but none of these were of the same high standard as the improved South African bred sheep.

When the South African stud Book was compiled in 1906, a special section was devoted to Blackhead-Persian sheep. The conditions for entry were very high, and only a few stud farms and a small number of animals were registered. By 1930, however, the number of stud farms had increased to 38 with almost 4,000 registered sheep.

Description of Breed.

(1) *The head and neck*, are black, with the black running evenly round the neck and extending no further than the neck. Horns are never developed in rams and ewes. The mouth and nose are strong.

* Photos 2 to 6 by A. Biggs, and No. 1 by the Grootfontein College of Agriculture.

The dewlap is well developed and hangs freely. The ears are moderately long and soft and are held horizontally. The neck is thick and well set, and should be in good proportion to the body.

(2) *Symmetry.*—The body is broad, deep and reasonably long. Special attention should be paid to breadth of the withers and the back (which should be as straight as possible) and to good depth of body.

A prominent broad chest standing out vertically, well-filled shoulders and buttocks, all endow the sheep with excellent mutton characters. The legs are fairly short, straight and squarely placed. The hoofs are black.

(3) *Size and Weight.*—In the marketing of mutton sheep, maximum size and weight are important factors, particularly in regard to the yield per sheep. Breeding alone will, however, not ensure good size and weight, feeding being the principal factor here. Full-grown rams and ewes should weigh about 150 and 115 lb. respectively.

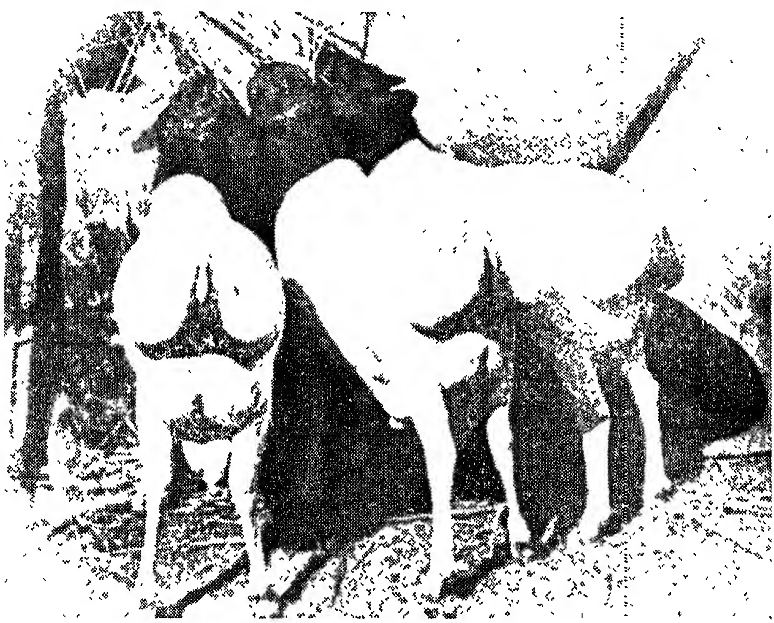


FIG. 3.—Blackhead-Persian rams at a hayrack.

(4) *The tail* consists of three parts. The largest or main portion must be broad and firm and close to the rump. It must not hang sloping downwards or taper into a point. The second joint of the tail is curved upwards and rests upon the centre of the first, tapering upwards to the apex and showing a black, clean skin area. This joint must neither be too large not too coarse. From the apex, which should, as far as possible, be in a straight line with the back, the third slender round little joint, or sjambok hangs perpendicularly over the bare skin of the second joint. The sjambok, which is about 2 to 3 inches long, is covered with short smooth hair. The tail as a whole must be well-balanced and must hang true, i.e. not on one side.

(5) *The coat* of the Blackhead-Persian sheep has no commercial value. The head and neck are covered with black hair and the rest of the body with dull white kemp inclining for the most part

backwards and downwards thus giving a fairly smooth surface to the cover. The hair is about 1 to 1½ inches long on the body, but is much shorter on the face and head.

There is also an inner coat of fine wool fibre, but the presence of too much visible wool in the outer cover is undesirable, detracting, in particular, from the leather value of the skin.

A detailed treatise on the cover of the Blackhead-Persian sheep is to be found in bulletin No. 82 entitled "The Blackhead Persian, a primitively-coated Fat-rumped Sheep", by Professor J. E. Duerden and Miss Evlyn Boyd.

Disqualifications.

In the selection of Blackhead-Persian sheep, the following count as disqualifications.

(1) Horns in rams and ewes.

(2) White spots on the head or white in the black of the neck. White hair on the mouth of a two-tooth or older sheep is permissible.

(3) Black spots on the body and legs or extension of the black of the neck beyond the neck. Black hair on the tail of a two-tooth or older sheep and a black spot on a leg, no larger than a pea, are permissible.

(4) Visible white spots on the black skin of the second joint of the tail.

(5) Any noticeably misshapen tail, e.g. a pointed or oversized low-hanging tail.

(6) Too much woolliness in the coat.

(7) Any serious defects in the build, such as a short muzzle, flat chest, pointed withers, hollow back, flat sides, X-hocks, undersize, faulty generative organs, etc.

Some of the above faults or defects, especially in respect of colour, are not so much shortcomings from an economic point of view but sheep displaying these defects do not conform to the requirements of the established breed properties as originally laid down in the stud book. In flock sheep such points will not be regarded in too serious a light.

Management.

The good characters, such as hardiness and ability to resist certain diseases are of special importance, accounting for the fact that this breed thrives in certain areas not suited to woolled sheep. This breed may therefore be farmed in areas where "steekgras" constitutes a serious menace, in mountainous and bush country and in the more arid parts of this country.

It does not, however, thrive so well in cold areas nor in high-rainfall areas. Extremes of cold often cause heavy losses among fat Persian sheep.

As a rule, Blackhead Persians are not subject to sheep-blowfly strike, are virtually immune to bluetongue and very resistant to heartwater caused by the "bont-leg" tick. These sheep may therefore be regarded as a suitable pioneer breed for the extermination of this tick, since, unlike the woolled type, they can be dipped regularly without injury to the fleece.

Blackhead Persians are, however, also susceptible to "geilsiekte" and especially to infection by internal parasites. Lambs should be carefully watched for tapeworm infection from about a month after birth. For the control of this parasite full-grown sheep and lambs may be dosed with remedies recommended from time to time by the Division of Veterinary Services.

Blackhead Persians are also attacked by small red lice and by the paralysis tick. For the control of the former the animals may be dipped in an arsenical dip and for the latter they should regularly be run through a footbath containing a $2\frac{1}{2}$ per cent. solution of sodium arsenite.

It is best to leave Blackhead Persian sheep to run undisturbed in well fenced-in camps, in so far as this is possible. A jackal-proof fence is eminently suitable for this purpose. The wires should be taughtly strained, otheiwise the sheep can easily wriggle through.

The provision of clean drinking water in concrete or similar drinking troughs is desirable, to prevent worm infestation. Salt and bonemeal licks are required to supplement phosphate deficiency in the grazing in certain areas or during certain periods, e.g. during the winter months or in times of drought. Where possible, green grazing should be supplied to the ewes during the winter months or during the lambing season in particular. This treatment will result in a better milk supply and will, therefore, safeguard the lambs against any form of starvation, ensuring more rapid growth and better size.

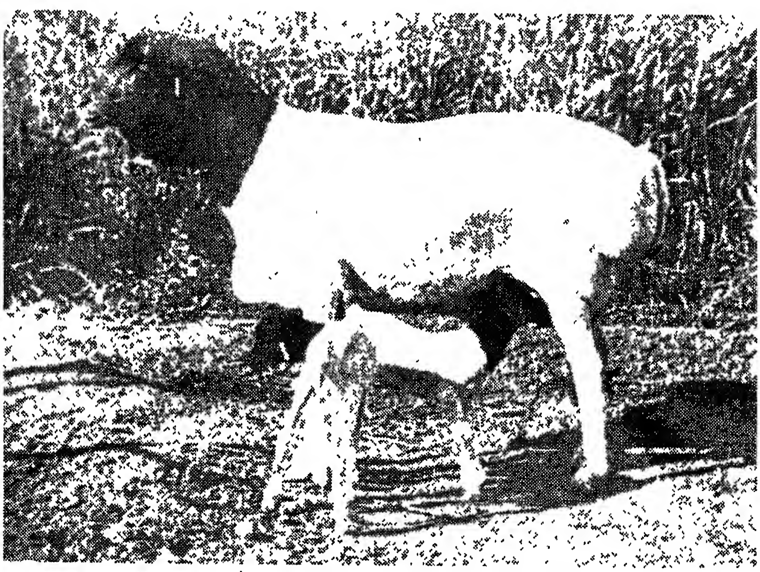


Fig. 4.—A Blackhead-Persian ewe with twin lambs.

Prolificacy is a striking attribute of the breed, the mating season extending over well-nigh the whole year. Lambs can therefore be born at just about any time of the year. On good pasturage a Persian ewe may rear three lambs in two years. It is advisable, however, not to overtax the ewes and to limit the lambing season to certain regular times of the year.

When the ewes lamb, they should be disturbed as little as possible. They are excellent mothers and seldom cast away their lambs. It is undesirable to mate the young ewes before they have reached the age of at least one year and have fully developed.

Ram lambs bred for slaughtering purposes are castrated at the age of about two to three weeks. Lambs may be weaned at the age of about three months. Uncastrated ram lambs must also be weaned as soon as possible, or rather a few weeks before the ewe lambs, for if left too long with their dams they may serve the ewes.

Farmers are warned against the malpractice of running Persian sheep and merinos in the same camp or kraal as one flock, since the coat of the Persian which is shed during certain times of the year, may land in the merino wool, considerably decreasing its value.

Improvement.

In order to improve a flock, thorough classing of the ewes should be carried out once a year. This is done by driving small lots of 20 to 30 into a small kraal, at the same time keeping a careful watch for possible faults or defects for which sheep may be rejected. After the rejects or culls have been removed, the mouths of the other ewes should be examined for age or faulty jaws.

In order effectively to judge uniformity of size and build, it is desirable to class the young ewes and the older or full-grown ewes separately.

Fig. 5.—Blackhead-Persian ewes.

Uniform sets of well-bred rams should be used with the approved ewes. The quality of these rams should be such as to ensure the retention of the general good characters of the flock and the improvement of the general defects.

Rams with the same defects for which ewes have been rejected, must not be used.

For Slaughtering Purposes.

Although in this country the Blackhead-Persian sheep is reputed for its mutton properties, the carcase leaves much to be desired when compared with those of the better-known mutton breeds from other countries. This drawback may be ascribed more specifically to (1) the large quantity of superfluous fat in relation to the quantity of meat; (2) the unequal distribution of the fat over the body, or rather the large accumulation or collection of fat on certain parts of the body, e.g. on the rump and at the sides; (3) the lack of meat, especially around the lower portions of the buttocks and shoulder; and, (4) certain weaknesses in the conformation of a mutton sheep, such as tendency towards pointed withers.

It is uneconomical to keep Persian hamel lambs until they are fully grown. In mutton-sheep farming it is important that lambs to be marketed should attain a marketable weight at an early age and while still in good condition, to obviate the necessity for the prolonged provision of good grazing. There is a good demand for lambs between the ages of 8 to 10 months and the prices obtained at this age are more profitable as compared with those obtained for sheep sold at the full-grown stage. With fairly good grazing conditions the live weight of lambs at the above age should be between 60 and 70 lb.

Crossbreeding.

Blackhead-Persian sheep play an important rôle in the crossbreeding of other mutton breeds. The ewes are also often used as stud stock in the production of karakul pelts by crossing them with pure-bred karakul rams and grading them up.

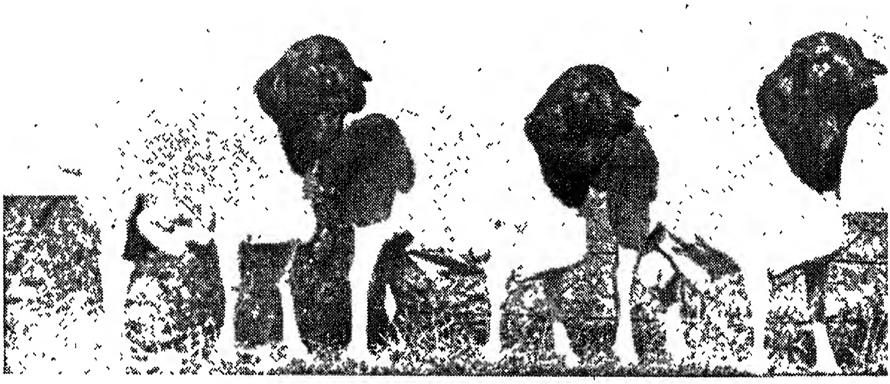


FIG. 6.—Blackhead-Persian rams.

Crossbreeding on Persian sheep with certain British mutton breeds, such as the Dorset Horn, the Southdown, etc., yields very good results, the crossbred lambs growing out more rapidly and being ready for the market at an earlier age. Moreover, a better milk production may also be expected from the crossbred ewes. A noteworthy improvement is also obtained in the mutton characteristics as compared with those of the pure-bred Persian, in that the crossbred sheep shows a smaller but more uniform distribution of fat and, on the whole, is better fleshed on the buttocks, the shoulder and the loins. The good characteristics of the Blackhead Persian, such as hardiness and its unlimited mating season are, however, retained in the crossbred sheep. Dorset Persian crossed rams are successfully used on non-woolled types of ewes for the production of high-quality slaughter stock.

Experiments on the crossbreeding of Blackhead Persians and the abovementioned British mutton breeds, in progress at certain experiment stations, are proving so successful that efforts are being directed at the development of new mutton breeds better able to thrive under South African conditions than the pure-bred British types.

The crossing of Blackhead Persians with merino ewes is not recommended since, apart from a decrease in the quantity of fat, such a crossing does not bring about any improvement worth mentioning in mutton characteristics and carcase weight. Apart from the danger of the presence of kemp in the wool of merino ewes mated

 [*Continued on page* 106.

Effective Milking Methods.

P. du Preez, Professional Officer, Division of Dairying.

THE proper stripping of a dairy cow is both an art and a science. On many farms this aspect of milk production does not receive its due attention. The milking process consists of more that mere pressure to the teats to allow the milk to escape. The treatment given to cows in their feeding and milking is very important, and no farmer who has spent money and time in establishing a good herd can afford to allow his milk yield to decrease by not paying the necessary attention to the milking process. Hence, for maximum production the harvesting of the dairy farmer's crop, viz. the milk, should receive special attention.

To give its maximum quantity of milk, the cow must be healthy to start with and then properly fed and milked. Correct methods of milking will entail a saving in time and labour, milk of a better quality will be produced, the milk production will be increased and there will be fewer cases of mastitis.

Saving in Time and Labour.

It is common knowledge that next to feeding, labour usually constitutes the biggest item of expenditure in milk production. For effective milking there must be co-operation between the milker and the cow. It is impossible to get the maximum amount of milk out of the udder if the cow does not " drop " her milk; consequently the cow must be taught to " drop " her milk when the milker is ready for the milking process. When the cow is ready, i.e. when she " drops " her milk, the milker must remove the milk from the udder as rapidly as possible.

Why a Cow "Drops" Her Milk.

The cow normally lets her milk " drop " when the calf suckles. The heat and moisture of the calf's mouth stimulate the nerves in the teat, causing secretions of a certain chemical substance or "hormone". This hormone causes a contraction of the muscles around the parts of the udder where the milk is stored, and this contraction allows the milk to drop to the lower portion of the udder. This is what takes places when a cow " drops " her milk. The cow may also be induced to " drop " her milk by light rubbing of the udder and the teats. The use of a wet cloth for rubbing the teats will not only induce the cow to " drop " her milk, but will also ensure a cleaner product.

Useful Hints.

The dairy farmer will find it worth his while to pay special attention to the following:—

(1) *Feeding and Milking at Fixed Times.*—Cows adapt themselves comparatively quickly to habit, and it is essential that the cows should be fed and milked at fixed times each day. If this practice is not followed, maximum milk production will be impossible, for the cows will then be thrown out of their routine. Cows must be fed according to their production. Too little feed reduces the milk

production whereas too much feed may have a detrimental effect on the digestive system and may therefore result in reduced milk production.

(2) *Cows must not become excited before or during milking.*—Milkers are only too well aware of the fact if the cows have been chased by dogs or have been frightened in any other way, they will be disinclined to let their milk " drop ". Any hindrance or nervousness will distrub the action of the hormone responsible for the secretion of milk; consequently the cows will not yield their maximum milk production. High producers are usually more prone to nervousness than others. The milking byre should be as quiet as possible. The milker must be patient and should know how to work with animals.

(3) *If possible, cows should be milked in the same order every day.*—Cows which are easily stimulated to give milk, (i.e. cows from whose teats milk drips already before milking) should be milked first, if possible, provided their udders are heathy. Cows whose udders are infected with mastitis, or those suffering from other diseases of the udder, should always be milked last and fastened separately in the byre. A good habit is to press a little milk out of each teat just before milking. This will enable one to tell at a glance whether the milk is healthy or not. Moreover, it will also ensure the presence of more butterfat and of fewer bacteria in the milk, since the first milk from the teats usually contains the most bacteria and the least butterfat. This foremilk may be fed to the calves.

(4) *Rapid milking is important.*—After the cows have been thoroughly prepared for the milking process by washing and massaging of their udders, they should be milked immediately and all milk removed from the udder as quickly as possible, to stimulate the effective action of the hormone which causes the cow to " drop " her milk. In machine milking, from four to six minutes are sufficient to allow of the removal off all the milk from the udder. Rapid milking requires more attention from the milker but the additional attention is amply repaid by the larger milk yield obtained by this method.

There are persons who maintain that it is essential to remove the last milk from the udder by hand after the milking machine has been removed. Experiments have proved this not to be neccessary in most cases, except if cows have " tough " teats or if the milk duct is very small. In such cases the farmer would be well advised to sell the cows to a butcher and keep only those cows which need not be stripped by hand. Stripping by hand after machine milking merely spoils the cows and encourages them to retain some of their milk when the milking machine is used.

(5) *Complete Stripping of Cows.*—If the cows are not stripped completely after each milking, their milk production will decrease and they will be inclined to dry up sooner than would otherwise have been the case. Between milking times milk is formed in the udder and stored there, and while this is taking place, the pressure in the udder increases until it reaches a certain stage after which the secretion of milk is suspended. If all the milk is not removed from the udder during the following milking, the pressure within the udder will increase more rapidly and the stage at which the secretion of milk is suspended, will be reached sooner than if the udder had been stripped completely.

High producers will produce more milk if milked three times a day instead of only twice, since, by removing milk from the udder more frequently, the pressure in the udder will be reduced more often; consequently more milk may be secreted and stored in the udder.

(6) *Incorrect milking method.*—As soon as the milker has removed all the milk from the udder he must immediately stop milking; if a milking machine is used, it must also be removed immediately. Experiments have proved that both methods of milking, viz. by hand or by machine, are injurious to the teats and the udder if continued after the milk has been removed, since mastitis may result. The tissues between the teats and the udder are soft and easily bruised; consequently, such an udder becomes susceptible to mastitis. While the milk is being removed by the milking machine, the udder relaxes and the teat end of the machine, if the latter is left on for too long, sucks up a larger portion of the teat and sometimes also a portion of the udder. If this happens the opening between the teat and the udder becomes smaller; consequently the tissues in the upper portion of the teat and in the bottom portion of the udder are bruised during the milking process. Proper milking will not damage the tissues of the teats and udder, and there will, therefore, be less danger of mastitis infection.

(7) *Cleanliness in Milking.*—Cleanliness in the byre and in everything which comes into contact with the milk is of the utmost importance. The udder and flanks of the cow should be cleaned before milking, and regular washing and disinfection of the byre is essential to prevent the spread of mastitis and other diseases of the udder. If a milking machine is used, all parts must be thoroughly washed and sterilized after milking, and if the cows are milked by hand, the milker must wash his hands in a disinfectant before each cow is milked. If the cows must sleep in the byre provision, should be made for sufficient straw, to prevent the udders of the cows from comming into direct contact with the concrete or stone floor.

The Milking of Heifers.

Cows become accustomed to the method in which they are milked within a fairly short period and the best time to train them is immediately after they have calved. If the milking is usually done by machine, this method must be employed from the outset and the cow must not be milked by hand during the first few days after calving. Neither must the calf be allowed to suckle, for frequently a cow in which " dropping " of milk has been reduced by a suckling calf, will later, when the calf is removed, refuse to " drop " her milk.

As a rule heifers soon become accustomed to quick milking if, about a month before calving, they are fastened in the byre with the cows, and their udders and teats are massaged and rubbed. This practice will also render possible the detection of any cracked teats which may then be treated.

Heifers require special attention when calving since their udders are often painful and hard. The farmer will, however, be amply repaid for the little extra time and patience expended with young heifers, for not only will he obtain a higher milk production, but he will also experience less udder trouble from his cows.

The Horse on the Farm.

IX.—Principles of Breeding.

Dr. P. J. Schreuder and F. B. Wright, Senior Professional Officers (Horses), Division of Agricultural Education and Research.

THE ordinary principles of breeding applicable to other classes of livestock also apply in the case of horsebreeding and it behoves the breeder to gain a good understanding of the wellknown basic principles of genetics *and* eugenics.

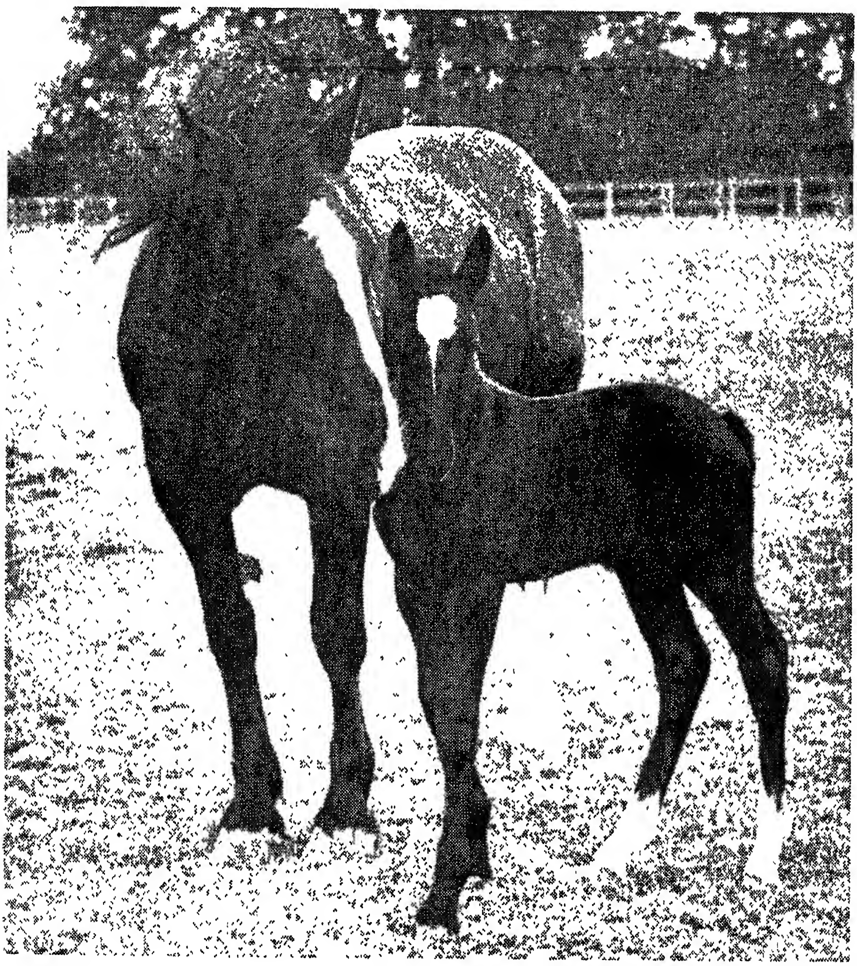
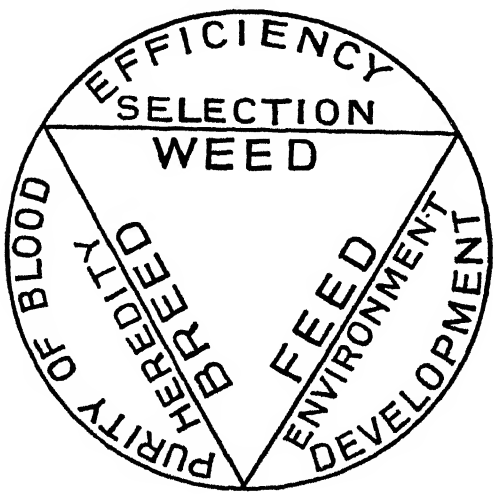


FIG. 1.—" Angleterre ", 26 years old. Longevity and fecundity are important physical qualities. Chivers and Son's legend in regard to this mare is: " Twenty years' service, repair bill nil ". Foaled filly " Fair Rose II " in her 23rd year (1944), now in the Government Central Stud, Grootfontein, College of Agriculture. C.P.

Breeding is an art. It is the intelligent control and direction of the inherent life forces of our stock with a view to maintaining the existing excellence of attributes and even achieving greater utility and perfection—and not merely an increase in numbers.

It is not proposed to enter into all the elementary factors of breeding but only to stress the most practical aspects of an intricate and elusive subject, namely the correct and successful mating of horses. The breeding of horses is approached in the same way as the breeding of dairy cows, long-term efficiency being the main objective rather than the production of animals for immediate profits and a short-term investment as in the case of steers, baconers or fat-lambs.

The elemental factors in breeding can be summed up in three homely words: "Breed, Feed and Weed". Breeding depends on heredity and aims at maintaining purity of blood. Feeding depends on environment and adequate development. Weeding directs selection and secures efficiency. These three factors are basic items in the production of all useful farm livestock and are closely interdependent one upon the other.



Heredity denotes what an animal inherits, both good and bad, from its parents and ancestors. By judicious and intelligent mating one seeks to propagate the good and eliminate the bad. The average practical horseman avoids defects commonly termed transmissible defects, such as bad wind and coarse bone. One aims at selecting individuals sound in limb in accordance with wellknown standards for good conformation and certain definite uitility attributes such as, for example, good wearing qualities, good temperament, longevity, stamina and fecundity. One studies carefully records of performances and breeding, pedigrees and family histories.

Environment denotes all the factors which govern the life of the animal—climate, food supply, temperatures, humidity, aridity, altitude, etc. To a very large extent environment is governed by methods of management and development. But even the best breeding, as represented by approved blood lines, pedigrees, performances and desired characteristics, will not give results without approved methods of development and management.

Selection is the key to the art of breeding. It is based on an intimate knowledge of breeds, types, individuals, breed standards and records of performances and breeding. The problem confronting the breeder is the production of a horse suitable for particular uses. The animal must suit the function for which it is required and the type must ultimately reach a high standard of uniformity and breed purity.

Often breeders rely too much on purity of blood, pedigrees or records of performances. Performance itself does not breed on, and acquired qualities, good or bad, are not transmitted; but the "will to do" may breed on. The physical make-up, conformation,

style, traits and disposition breed on. It is reasonable to expect the progeny of good performers to inherit excellent conformation, good disposition, stamina, and other good characteristics and physical qualities from their ancestors.

Terms and Definitions.

Prepotency is the power to " breed on " or transmit in a high degree various salient characteristics and likenesses.

Fecundity is the regularity of reproduction.

A cross-bred is the progeny of two pure breds or a pure bred sire and a grade mare.

A pure-bred is an animal without alien or impure blood.

A grade or *high-grade* animal is the progeny of a pure-bred sire and improved dam. The more pure-bred sires in its breeding the higher the grade.

Half-brothers or *half-sisters* are animals out of the same mare by different sires, or *vice versa*.

FIG. 2.—Cross-bred Percheron mares from light country-bred mares. Western Orange Free State.

Full-brothers are animals out of the same mare and the same sire. Blood brothers are by the same sire out of full sisters; by full brothers out of full-sisters; or by full-brothers out of the same dam.

A foal is a young unweaned horse of either sex.

A weanling is a foal after weaning and under one year.

A yearling is a weanling over one year; after that it becomes a two- and three-year-old colt or filly.

A filly is a female horse 4 years and under.

A colt is a male horse 4 years and under.

A mare is a female horse over four.

A horse or *stallion* or *entire* is a male over four.

A gelding is a castrated colt or horse.

Breed, Type and Pedigree.

The continuous judicious selection of any class of farm animals according to a standard comprising certain groups of character traits, utility merits and conformation features will ultimately produce a type.

The type is often more important than the breed. In the formative histories of breeds the horse was more important than pedigrees, but the performances and ability of that horse were packed up by all that good breeding, training, proper use and care could give. He and his likes were coveted possessions and bred on. In this way families of a type are developed, and the families establish a breed.

Although light breeds of horses have much in common, there are very particular points of difference that declare the breed. Study closely the points of difference of a famous race horse with a champion saddle horse, say, Man O'War and King's Genius. In describing the two, experts are practically in verbal agreement, yet the two animals differ widely in utility and performance aspects.

Selection for a definite set of characteristics over long periods has brought about differences that definitely differentiate the two animals and also their breeds. The differences are mainly to be observed in conformation, temperament and performance.

In addition to these there are certain fundamental qualities common to great horses of all breeds. In the two superior specimens of two distinct breeds, the Thoroughbred and the Saddler for example, the fundamental points of similarity are: finely chiselled heads with good muscles; nostrils capable of expanding appreciably; big, intelligent eyes; smart, well-set ears; clean throat latch; well-set necks; good top and forehand; deep heart girth; short, strong backs with powerful loins and long hips; long sloping shoulders; well muscled arms and stifles; flat and good bone below the knee; flat, clean joints in knees and hocks; and good round feet well off the ground. These fundamental points are found in a superior degree in both animals, and yet they cannot be mistaken one for the other as breed specimens. It is type that differentiates, the manner in which conformation, temperament and performance are blended, and function in the individual.

There are also other important physical qualities closely associated with differentiating features in the best of different breeds, namely, gentle temperament, willingness to work or submit to the riders' directions, intelligent aptitude for training, commanding presence, and well-mannered but alert attention.

Longevity and fecundity are important physical qualities, especially in horses prepared for long-term efficiency—qualities that apart from good breeding depend very largely on good rearing and good usage.

Cross-breeding.

Cross-breeding has been the most fruitful system of breeding to produce useful animals possessing certain utility and economic attributes.

In the main this system is applied to obtain an immediate or temporary improvement of existing types or breeds, as, for example, in the case of cross-bred steers, baconers and fat-lambs. The cross-bred not only combines the best of the two breeds in itself, but often possesses a hybrid vigour not possessed by either parent breed.

Judicious cross-breeding of types and breeds is a fundamental factor in the formation of new types and breeds, provided that future generations are selected on a fixed standard of excellence for the type or breed in formation. The experienced horse breeder should not

hesitate to mix bloods of different breeds, provided he does so according to the dictates of good management and a set ideal, and mates selected animals within the type.

The advocacy of the maintenance of purity of blood is readily admitted, but there is no sense in maintaining blood purity just because it is pure. If the creators of the world's great breeds of livestock stuck to this theory, our livestock industries would be much the poorer. On the other hand, however, it would be disastrous to continue injudicious cross-breeding without plan or reason.

Cross-breeding must lead to fixity of type as prescribed by a standard of efficiency and type. In the formative efforts towards the establishment of a type or breed, the breeder often resorts to inbreeding in order to obtain fixity of type. As has already been said, breeding is an art, and the creator of a type must therefore be well-versed in the processes of inheritance and be able to judge correctly the results of matings.

In the light of history, both ancient and recent, we find all we need in precedent to encourage us to mix bloods hopefully when an analysis of the individual horses we are working with suggests the

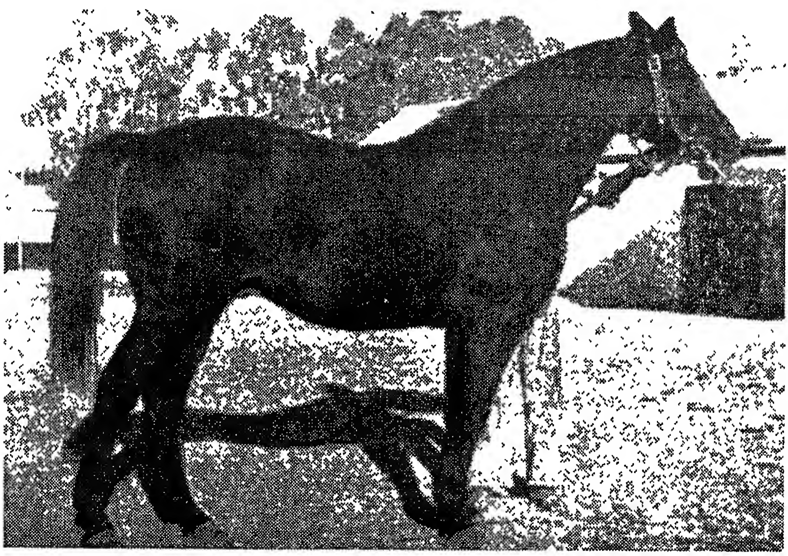


FIG. 3.—The Thoroughbred "Kenilworth III" used in the Government Horse Improvement Scheme for light-horse stock.

probable production of better progeny, or progeny just as good as either parent but possessing traits and attributes desired in a new type for certain specific uses. On these lines were created (or are still in the formative process) such newer breeds as the Tennessee Walking Horse, the Quarter Horse, the Palomino and several other types. All the light breeds trace back to the Arab or to breeds infused with oriental blood.

In countries with large numbers of different light and heavy breeds many combinations are possible.

In selecting sires it is of the utmost importance, other things being equal, to secure confirmation that they represent a family of fixed type and established quality and merit. Many fine

individuals fail to reproduce themselves—they have inherited individual excellence but lack fixity of breeding or prepotency—while individuals of a great family far from prepossessing in themselves often beget progeny of rare quality, style and merit. Very often the " flashy " but poor breeder is just an individual, while the other is an institution, a line of breeding, that represents a family of fixed characters.

Prepotent Sires.

It is most remarkable what intensive use was made of prepotent sires. Practically all the breeds owe their rapid progress and consolidation and fixation of breed characters to a few sires of outstanding merit and prepotency.

These foundation sires, once their desired merits were known, were used widely and intensively and their influence more than any other factor established a type which consolidated distinct breed characteristics. Practically all breeds claim such foundation sires. The Shire breed had its " Black Horse " and others; the Clydesdale its famous old " Blaze ". and others; the Percheron its " Jean le Blanc " that died at the advanced age of 32 years " exempt from all blemish "; and the Suffolk its " Crip Horse of Ufford ", foaled in 1768. " Justin Morgan " founded a breed and his blood aided the Saddler.

No standards existed during those early days, but the guiding principle was: individual merit, soundness, good wearing qualities of legs and feet, reproductive ability, and attributes and qualities that would meet the demand for specific uses.

Some of the formative types possessed in a large measure coaching blood. They possessed good action, good feet, and stamina so essential for good service on the rough stone block roads of that age. Strict selection on a definite utility basis established in the course of time distinct draught types with weight, power and good wearing qualities. As a result of the application of certain principles of breeding—line and inbreeding and community and stud-breeding measures—these types were ultimately developed into pure breeds.

Various community measures for the improvement of these breeds were practised in different countries, the most common practice being to patronize stallions that sires " useful " farm horses. These either stood at stud or " travelled " the countryside at a stud and groom fee. Our light-horse stock to-day is still predominatly Anglo-something-or-other.

We can therefore accept it as a fact that our best country-bred mares of this type and their offspring by purebred sires of the different breeds will approximate those obtained in matings where the breeding is established with greater accuracy. There is sufficient evidence everywhere that this is fortunately the case.

To guide our horse breeders it would be profitable to record the results of matings—of cross-breeding and grading—used in the creation and establishment of different breeds and breed types. The progeny of a mating of a Thoroughbred to a light mare with Anglo-something strain are likely to be good remounts and general utility horses. If the mare is of Hackney strain, then good hunters, hunter hacks, saddle horses and light harness-horses may be expected; if of Saddler strain, then the chances for good saddlers will be still better; if of Percheron strain, then heavier saddlers, hunters and heavier harness-horses may be expected.

The American Saddler or Arab—both saddle types—mated to mares of "Anglo-other light-horse breeding" would in the main produce horses of outstanding general utility qualities, good remounts, light harness horses, and possibly good hunters; mated to Anglo-Percheron type of mares good remounts with increased weight and carrying capacity may be expected.

The Thoroughbred, Saddler or Arab mated to Anglo-other draught-breed type of mares will in the main give the same result as is obtained from an Anglo-Percheron type of mares, but with less promise of good results until bred back to sires of the original breed, especially Thoroughbreds.

Of the above three light breeds the Thoroughbred is expected to give better results with the ordinary run of country-bred light mare, whether she is of Anglo-light breed or of substance. Superior bone and quality remains the great improver of light-horse stock, but the contribution of selected other light-horse attributes adds appreciably to the wider utility qualities of our ordinary light, cross-bred or half-bred stock.

The influence of the draught breeds on our horse stock is very slight, but increases appreciably. As stated elsewhere in this series of articles, South Africa needs two utility types of horses—light and

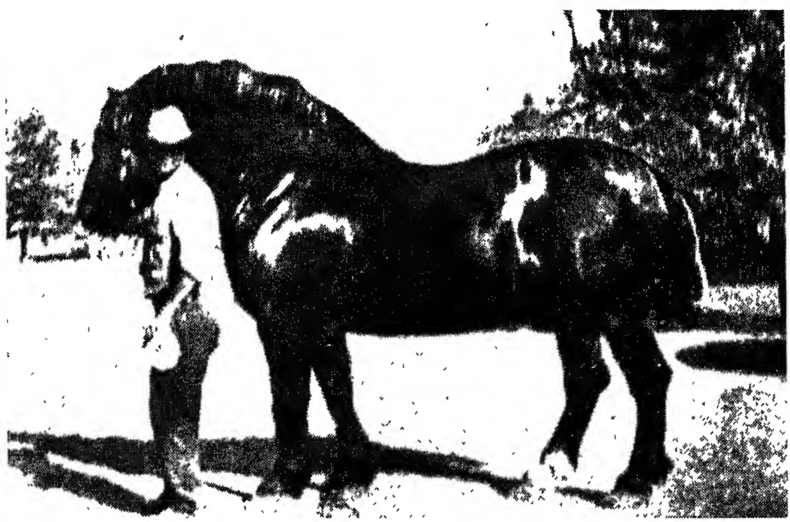


FIG. 4.—The Percheron Stallion "Viscount", imported from Canada in 1925, who laid firm foundations in this country. Note the low-set, sturdy conformation and good bone.

heavy to medium heavy. Registered stallions of the leading breeds of these types bred to our best selected country-bred mares will furnish excellent material to establish our own breed types, provided breeders through horse-improvement schemes and breed societies and other organizations follow a purposeful standard and apply approved measures for maintenance and development.

In this building-up process the numerous in-between types would furnish most useful material for the breeding of high-class mules. The best mule mare is a cross-bred or grade that possesses weight and size—the progeny of draught-breed sires from good country-bred light stock or the progency of heavy farm work-horse stock bred to light-breed stallions of substance.

The Stallion at Stud.

The mature stallion can serve from 40 to 100 mares during the breeding season. A two-year-old should be used very lightly—8 to 10 mares—in order to secure evidence of his breeding ability. To preserve the breeding virility of a stallion 30 to 40 mares at 2 to 3 a week are considered sufficient during a 3 to 4 months' breeding season.

Virility in stallions varies greatly and can be established by the number of foals he sires and his condition of health. The Clydesdale stallion "Dunure Footprint" sired more than 200 living foals in one season and remained virile until his death at 19 years of age.

The true value of a sire is measured by the number of meritorious offspring rather than the number of services.

Breeding Considerations.

In addition to what has been said in chapter V (*b*)*, the following considerations must be noted and even bear repetition.

In this age of mechanization only horses that can co-operate with mechanized power will have a place in the agricultural and industrial activities of a nation. Therefore they must be of the best. Not how many, but how good, should be the dominating policy of every horse breeder.

It will in most cases be better for the average farmer to have a few top horses than a large number of mediocre animals. It is always wiser to breed the mares to the very best stallion obtainable. Under the Goverment Horse-Improvement Scheme, good stallions for the use of farmers are available at twelve stations in the different provinces. It behoves horse breeders, therefore, to pay greater and more expert attention to their horse studs.

The breeding stock must be sound in all respects, and in good health and condition at mating time. The natural breeding time is in the spring or early summer—October to January. Modern farming methods, however, often demand that mares should foal during the season when the heaviest part of the farm work is over. In the autumn most of the summer ills that worry and often retard the development of foals are not present and on intensive well-balanced, progressive farming propositions there is then sufficient feed supplies to offset the absence of grazing. During the comparatively idle winter months the mare can give all her attention to the foal and by the next spring it can be turned to grazing and maintained at little cost. Autumn foals, however, must receive good care during the first winter—a little grain and protection from the cold and winter winds are most essential.

The gestation period in the horse is about 340 days (330-360) or about eleven months. It is generally accepted that healthy, vigorous mares conceive most readily about 7 to 9 days after foaling. If she is bred then, the next foaling date will be earlier by almost a month and therefore it becomes necessary to breed her on the second or third heat period, so as to secure foals in the desired months of spring. For autumn foaling she will have to be served in April or May, a time when mares do not come into season so readily. The feeding of lush green feed, wheat middlings and oats may bring on oestrus more readily.

* *See* "Feeding and Management of Stallion, Mare and Foal" in the April, 1947, issue of *Farming in South Africa.*

The mare will be healthier and the foal stronger at birth if she is used at slow, regular and moderate work nearly every day. Parturition will also be easier. The records of well-managed studs show a higher foaling percentage where brood mares are work units and receive good treatment and feeding. Work horses earn good rations, especially if they are brood mares nursing valuable foals or are due to foal. To repeat, proper feed of sufficient quantity and quality and variety regularly supplied, uniform and moderate work and careful handling will maintain an in-foal mare in proper physical condition to develop a healthy strong foetus.

Mating Methods.

A low foaling percentage is most often due to the ranching method of letting the stallion run with the troop. This extensive and wasteful ranching method is becoming out-dated except perhaps in the case of mule breeding on a large scale.

Taking the mare to the stallion gives better results. The proximity and approaches of the stallion or teaser will readily draw the attention of a mare on heat; she is then brought into the enclosure next to the common paddock. Here a stanchion consisting of two poles four feet high and 12 feet apart, with wooden and padded rails across, is erected. The stallion is placed on the left side and the mare on the other. Both animals are kept under control and permitted the usual approaches. When all is in order, the mare is pulled forward away from the barrier and the stallion allowed to approach her from the left.

Some mares resent the stallion's attentions although the heat period has been correctly established. For such mares hobbles may be used. A collar made of any good rope is tied loosely round the neck, and traces of soft rope are buckeld round the hocks or even the pasterns and tied to this collar with a slipknot which will readily loosen if a great strain is put on them, should the mare struggle or the stallion become entangled in the traces.

After service, the mare should be given plenty of time to rest in a quiet paddock and not worked for a day or two. Very often there is too much hurry, so that the mare is forced to take service before she is just right. In cold weather the mare is warmed up by a little exercise, but she should not be served if hot or fatigued. She must be returned to the teaser or stallion within 18 to 21 days to be tried and rebred if necessary. Her feeding and routine, except for a rest of a day or two after service, should not be altered between heat periods.

At service the mare's tail should be strapped on the right side to her neck or may be bandaged for about twelve inches to hold the lose hair of the tail. Careful grooms wash the genital organs of both animals with a mild disinfectant before and after service.

At Parturition.

The good groom "sits up" unobtrusively with the mare to foal a valuable colt. Often foals are lost at birth as a result of being smothered by a film of tissue or membrane over its nostrils; those must be removed at once. If respiration does not start immediately, blow into the mouth, work the ribs and rub the body vigorously with a wisp of straw or clean rag.

Disinfect the feet, nostrils and navel cord carefully and remove the afterbirth and all dirt and burn it. Disinfect the stall or place

where the foal was dropped. Such cleanliness is a very good precaution against any infection, especially navel ill in the new-born foal.

Oestrus.

In the normal mare, ova are constantly being extruded from the ovaries in a regular cycle. The ovum is contained within a small follicle, which in addition to the ovum is filled with fluid and gradually pushes above the surface of the ovary like a blister. The follicle continues to increase in size up to a point when it bursts and discharges the ovum into the oviduct down which it is carried to the womb. If fertilized, it lodges here and develops into a foetus. If it is unfertilized, it dies and is passed out. When the follicle has attained a certain size, the mare comes into heat and remains in heat until the follicle ruptures. Heat comes to an end approximately twenty four hours after the rupture of the follicle. If fertilization occurs, the follicular development and heat are suspended until after the birth of the foetus.

The heat period is technically spoken of as oestrus, and the period between heats as dioestrus. Mares do not usually come into heat during the winter period and this period of sexual frigidity is spoken of as anoestrus.

Having briefly described the normal sexual cycle in the mare, we may now study some of its practical implications.

(1) The length of time the follicle takes to develop varies considerably from mare to mare, and if we remember that the mare is in heat while the follicle is undergoing all but its early development, it follows that the heat period will also vary. The average heat period may be placed at five or six days, but may be a little less and is frequently a few days longer. Sometimes the follicle develops so slowly that the mare may be in heat for sixty days or more.

(2) On the other hand, the period of dioestrus is fairly constant, viz. about sixteen days. Consequently, a mare with a five-day oestrus period and a sixteen-day dioestrus period will complete her sexual cycle in 16 plus 5, i.e. 21 days—the accepted average—whereas a mare with a nine-day oestrus period will complete her sexual cycle in 9 plus 16, i.e 25 (twenty-five) days. This has an important practical bearing. Many people think that, if a mare does not come into season twenty-one days after the first heat in which she may have been covered, she has held to the horse, while in reality the mare is still in the dioestrus period, not having completed a second sexual cycle.

(3) The ovum is not set free until approximately twenty four hours before the cessation of heat. The ovum cannot be fertilized until it has left the ovary and as spermatozoa do not live indefinitely in the genital tract of the mare, the earlier services during a heat period—especially a long heat period—are not likely to cause conception. In practice it has been found that the greatest percentage of fertile matings take place at approximately two days before the ovum is liberated. The liberation of the ovum from the ovary is termed ovulation. Earlier and later matings will not all prove to be infertile, but the chances of conception decrease in proportion to the legth of time that elapses between the actual mating and this optimal period two days before ovulation. This is an important point where a stallion has many mares to cover, as the earlier services during

 [Continued on page 130.

The Snouted Harvester Termite.

W. G. H. Coaton, Division of Entomology, Pretoria.

THE snouted or mound-inhabiting harvesters collectively form probably one of the most widely known groups of termites in South Africa, their domed or conical mounds forming a typical feature of the landscape over the greater part of the country. The mounds are popularly used for the surfacing of tennis courts, and the insects contained in the fragmented "ant-heaps" as poultry food.

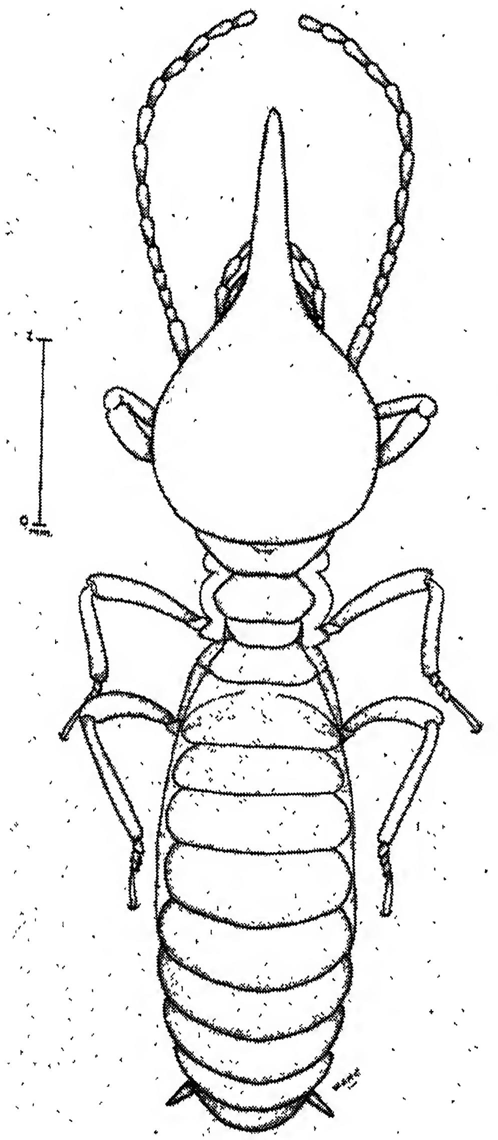


FIG. 1.—Major soldier of *Trinervitermes havilandi* Hgrn.

Speaking in general terms, mound density in the grass and mixed grass-karoobush veld of the central areas of the Union is greater than along the coastal belt and in the northern bush-veld, and appears to reach its peak in the semi-arid region of the Orange Free State west and south-west of Bloemfontein, in the south-western Transvaal, and in parts of the Cape Province, especially from the vicinity of Belmont to north of Kimberley.

The species, of which seventeen have been recorded from the Union, belong to the genus, *Trinervitermes*. All of them are grass-eaters, selecting specifically the finer grass types as their food. When an inhabited mound is broken up, the interior will be found to be crammed with cut grass lengths even when the surrounding veld is practically devoid of grass cover. Under normal conditions, with the individual mounds widely separated from one another, the destruction of the grass cover of the veld by these termites does not assume serious proportions, but in areas of gross infestation where peak mound densities have been attained, the stock-carrying capacity of such veld may be seriously lowered.

In one area of the Koffiefontein district where *Trinervitermes* infestation had built up to extremely high levels, a survey revealed that mound density over a 1,400 morgen block averaged about 100 per morgen of which an average of 70 per morgen were inhabited, giving an estimated total number of mounds for the whole area of 140,000 of which 98,000 were inhabited. The mounds varied considerably in size, from insignificant ones of the size of a man's fist to mammoths with a basal circumference of 28 feet and a height of just under 4 feet.

Surveys revealed that the colonies in 70 inhabited mounds per morgen in the area in question were capable of destroying during the course of a normal dry winter just under 20 per cent. of the standing grass cover of the veld. Given summer drought with little or no regrowth of vegetation and an ensuing dry winter, it would thus be possible for the termites to destroy up to 60 per cent. of the grass cover. It is thus abundantly clear that where such peak infestations have been attained, the stock-carrying capacity of the veld may be considerably lowered, and before this can be restored the *Trinervitermes* population will have to be considerably reduced by control operations.

The loss, moreover, seems to go much further than the actual destruction of grazing since the activities of this termite must tend to cause the elimination of certain elements in the grass complex by preventing reseeding, and generally facilitate desiccation of the soil, the run-off of flood water and eventual erosion. In regions of high mound density, the total area occupied by the mounds and thus unavailabe to vegetal growth may also take up a fair proportion of the area as a whole.

The Nest System.

Beneath an extremely hard outer crust, the interior of the mound will be found to consist of a maze of inter-connected passages which collectively give it a spongy highly cellular appearance. The cellular structure extends downwards into the soil beneath the mound, usually to a depth of about 12 inches and seldom exceeding 2 feet even with the largest specimens. From the subterranean portion, permanent passage ways radiate outwards to the feeding grounds like the spokes of a wheel from the hub, these running usually at a depth of about one inch below the soil surface. The main foraging passages are inter-connected by laterals, giving the nest system when plotted on paper the appearance of an irregular spiderweb with the mound at its centre.

At its termination each foraging passage breaks up into a number of fine tunnels which open up on the surface through small circular holes which are sealed up with mud plugs when not in use. From these harvesting holes, always under cover of darkness, hordes of workers emerge into the open to glean grass supplies. Cut lengths are dragged underground to be conveyed via the subterranean passages to the central mound for curing, storage and consumption.

It has been established by the writer that during periods of grass scarcity, when greater distances have to be covered to secure the necessary food supplies, supplementary mounds are contructed over the main foraging passages away from the central mound for the temporary housing of harvesting parties and storage of the grass supplies gleaned by them. It has furthermore been determined that, once rains have fallen and grass again becomes plentifully available

near the central breeding mound, the supplementary mounds, being redundant, are voluntarily deserted by their inhabitants and fall into a state of disrepair.

Overgrazing and its Effect on Mound Density.

The connection between overgrazing and peak *Trinervitermes* infestations first became apparent in the years 1946 and 1947 when surveys were made on heavily mound-ridden veld at Koffiefontein. The area where the studies were made consisted in the past of a number of farms of uneconomically small size which had in consequence been heavily overstocked. The grazing as a result had deteriorated to an extent where it was well nigh impossible for the owners to withstand the frequently recurring periods of drought. A few years prior to 1946, these farms had been bought up by the present owner and amalgamated to form a large unit within which it was hoped to restore the pristine carrying capacity of the veld by sound grazing practice. It soon became apparent that two obstacles effectively prevented satisfactory veld recovery. namely, the hold which the shrub *Gnidia polycephala* (E. May) Gilg, commonly called Januariebos, had taken on the veld, and the extremely high *Trinervitermes* populations on the same areas.

During the spring of 1946 the area in question was a blaze of bright yellow, providing striking visual evidence of the heavy stand of Januariebos present on it. Since this shrub is both unpalatable and poisonous to stock, it seemed reasonable to assume that past overstocking of the veld was responsible for the encroachment. By selective grazing the stock would prevent adequate reseeding of grasses and the Januariebos would be free to invade the veld at an ever-increasing rate. Dr. Henrici, Officer in Charge of the Veld Reserve, Fauresmith, confirmed the assumption in the following words: "I consider a heavy stand of *Gnidia polycephala* a sign of overstocking, particularly in our sandveld or so-called middleveld. You are quite right in your assumption."

The striking feature of the area studied in Koffiefontein was the fact that almost invariably heavy stands of Januariebos were associated with extremely high *Trinervitermes* mound densities. It could perhaps be argued that the termites themselves by their selective destruction of the veld grasses provided the Januariebos with the opportunity of gaining the upperhand in the vegetal complex. This would not, however, explain the elimination of the nutritious karoobush in the same areas, since this is not destroyed by these termites. Moreover, according to surveys made, the *Trinervitermes* colonies present in these areas destroy only about 20 per cent. of the standing grass cover in the course of one winter season despite mound densities averaging 100 per morgen, and it is not considered that they alone can be held responsible for the prevention of normal reseeding of the grasses. It seems logical to assume that both heavy stands of Januariebos and high *Trinervitermes* mound densities are caused by continuous overgrazing over a period of years. All available data support this contention.

In the first place there is the definitely established fact that each *Triververmes* colony constructs supplementary mounds during periods of grass scarcity when wider areas have to be scoured to secure the needed food supplies. Any factor or group of factors which would reduce the grass cover appreciably, would thus be directly reponsible for an increase in the number of mounds. Low and irregular rainfall and periodic summer droughts would have this

effect, especially when heavy grazing adds to the removal of, and prevention of regrowth of, the grass cover. Winter burning of veld would also create conditions favouring increased mound construction. The inhabitants of the mounds are not destroyed by fire, since they escape the heat in the mounds by fleeing to the cooler subterranean levels while it persists, but the bulk of the food supply of the termites is destroyed. It is of interest to note that one area in the Pretoria district over which grass has regularly been burnt in winter for many years, carries one of the heaviest mound densities to be seen in this region. Overgrazing, by keeping grass in short supply, must play a similar rôle and the effects will be most apparent where the rainfall is too low to ensure rapid regrowth. This factor can be expected to play its most important part in the arid and semi-arid regions.

The increase in mound densities attributable to the factors mentioned above does not necessarily imply a corresponding increase in *Trinervitermes* populations, since the bulk of the supplementary mounds will be deserted as soon as grass supplies increase. But it was established at Koffiefontein that the presence of large numbers of deserted, dilapidated mounds in the veld would, over a period of years, tend to increase the number of colonies present per unit area.

Out of 764 mounds examined in an area of high mound density, 260 had fallen into a state of bad disrepair and had obviously been deserted by their previous inmates for some time. Of the latter, approximately 25 per cent. had new young colonies starting up at their bases and had clearly become reinfested. Mounds were uncountered where the new colonies had taken over and rebuilt the greater portions of the old mounds, and in some cases the latter had been nearly completely enveloped by the new structure. In subsequent eradication tests in the same area large numbers of the most massive inhabited mounds were found to contain the immensely hard cores formed by the matrices of sunbaked deserted mounds which had been incorporated in the new structure. It was clear that the rate of reinfestation of deserted mounds during the swarming seasons must be high. The explanation of this phenomenon became apparent through subsequent observations in Pretoria and the Orange Free State during the months when *Trinervitermes* swarming was taking place.

After a brief period of flight, the female winged reproductive settles on some elevated surface, raises the tip of her abdomen and by vibrating her wings wafts upwards an aroma attractive to the male of her species. When the male alights beside her, both individuals shed their wings and move off to find a suitable spot at which to burrow down into the soil. It is during this period, between swarming from the parental mound and the time the paired couples have reached comparative security beneath the soil surface, that the imagos are most vulnerable to attack by the hordes of predatory enemies which beset them at such times. Any factor which would shorten the period of exposure to natural enemies would tend to increase the survival rate of the colonizing pairs.

On the featureless plains of the Orange Free State, especially in years when a tall stand of vegetation was absent, it was remarkable to observe how frequently the females called the males from the elevated surfaces provided by existing mounds. If such a mound was inhabited, the hard outer crust would be intact, and the paired couple would descend to the soil surface and scurry around before digging in. In cases where the mound was not inhabited and holes

had appeared in the outer crust as a result of weathering, ready entry into the deserted interiors was provided. Paired couples on such mounds almost invariably took advantage of these holes, and were in consequence exposed to attack by predators for much shorter periods than those couples which had to make their way to the soil and laboriously burrow downwards. Apart from increasing the survival rate of the colonizing individuals, the fact that there are ready-made mound structures over the sites of the incipient colonies must considerably speed up the development of the latter by cutting down on the time and effort needed to erect such structures *de novo*.

After good spring and summer rains, regrowth of the grass cover will result in desertion of supplementary mounds on previously overgrazed veld. In other words, overgrazing would normally result in large numbers of deserted mounds being available for colonization just at the time when swarming is about to take place. In addition then to the normal small crop of new colonies developing in virgin soil—a number normally counterbalanced by natural mortality in colonies already established—there will in overgrazed veld be an ever-increasing number of new colonies turning what were previously supplementary mounds into independent breeding mounds. Each of these will in periods of grass scarcity construct its own complement of supplementary mounds . And so the process would appear to continue, the ratio of inhabited mounds fluctuating seasonally, but ever increasing in respect of the gross total, until eventually the termite population in relation to available grass supplies reaches saturation point. One morgen of such *Trinervitermes* saturated veld at Koffiefontein, where the effects of overstocking still prevailed, 264 mounds were counted, of which no fewer than 138 were inhabited.

Where infestations have reached such peak levels it is hardly likely that merely resting the veld for a period of years would result in a decrease in the number of colonies. Such a practice, by increasing the available grass supplies, would ensure that none of the already high number of existing colonies would perish through starvation, and might even facilitate the establishment of yet more colonies in an area previously saturated. Nor can it be expected that veld recovery will be very rapid in areas which carry such high *Trinervitermes* populations built up as a result of bad pastoral practice in the past. Under such conditions reseeding of grasses will be slowed down considerably by the termites themselves. Dr. Henrici pointed out to the writer that in her experience, once veld carried a heavy *Trinervitermes* population, grass recovery took very much longer even if artificial reseeding was practised. This retardation of veld recovery in such areas, clearly visible in Koffiefontein when the studies were made, suggests that in any reclamation work planned in such areas, *Trinervitermes* control should form a basic and integral part of the programme.

In applying reclamation methods to areas carrying peak *Trinervitermes* infestations, the correct procedure would appear to be a drastic reduction of the number of colonies by a method which would not only destroy the insects but level off the mounds as well. to be followed thereafter by sound grazing practice which would maintain the balance of nature by ensuring as far as possible at all times an adequate vegetal cover. In extreme cases sound grazing practice may have to be preceded by reseeding the veld and eliminating undesirable bush encroachment.

Dr. Henrici, when asked whether the other outcome of overstocking in Koffiefontein, namely Januariebos encroachment, could

be overcome by merely resting the veld, or whether direct eradication was necessary, replied that no direct experiments had been conducted in regard to the removal of Januariebos from veld, and that she could thus give no answer based on experiment, but other undesirable bush like bitterbos (*Chrysocoma*) had been destroyed and the result was marvellous. She was of the opinion that one could obtain similar results by simply sparing the veld, but as the area has such a low irregular rainfall, it took a *very* long time to restore the veld in this way, and she therefore thought that the removal of Januariebos could be advocated.

Accelerated Mound Demolition.

During the 1946 tests at Koffiefontein it was discovered that those mounds with basal circumferences of less than 6 feet were easily lifted bodily by chopping in at their bases with broad-bladed bushpicks and levering them up intact. Such mounds, which in the test area averaged 57·4 per cent. of the total, were easily removed and fragmented, and the subterranean nest structure could be fumigated with a minimum consumption of time. Those mounds

FIG. 2.—Cutting the mound by animal traction, the crowbar being held in position.

with circumferences ranging between 6 and 10 feet (22·0 per cent. of the total) were in general harder, and more time and labour were required to fragment them since they had to be broken down bit by bit. The largest mounds, those with basal circumferences of more than 10 feet (20·6 per cent. of the total) made the highest demands on the labour force. Many of them, especially those frequently-encountered specimens containing hard internal cores composed of the sun-baked matrices of what were previously deserted mounds, were so difficult to fragment that it frequently took a labourer half an hour or more to reduce one of them down to ground level. It was realized that if some time-saving method of reducing the average of 40·6 per cent. of larger mounds per morgen could be evolved, the labour force required could be considerably reduced and control operations would be speeded up.

The idea of using a flexible steel cable drawn by oxen or donkeys to cut through the mounds at soil level was first thought of by

Senator the Hon. A. M. Conroy. Once the mound is separated from its base, it can be upended and attacked by pick from its softer interior instead of through the extremely hard outer crust. In consequence it can comparatively speedily be split up into smaller sections which are in turn fragmented with ease. This seemed to be a promising, labour-saving line of attack, and field-scale tests were started at Koffiefontein to determine its practicability.

The most suitable cable for the purpose proved to be a flexible steel hawser such as is used in the mining industry. The diameter was approximately ¾ inch. Thinner cables snapped when really hard mounds were encountered. One end of the cable is looped, the loop being sufficiently large to encircle the largest mound likely to be encountered, with a good bit to spare. An extra large loop ensueres that maximum pressure is brought to bear on that part of the cable which does the cutting into the mound. The other end of the cable is attached to the trek-chain drawn by a team of 12 to 14 oxen or donkeys.

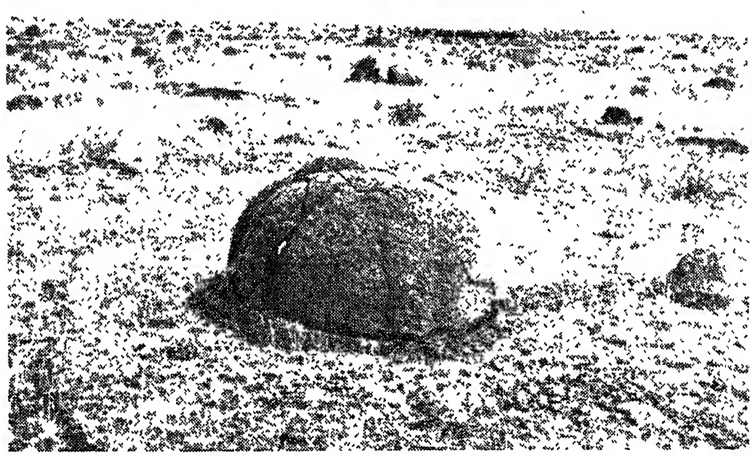


FIG. 3.—The mound cut off at its base by the traction method.

The loop is thrown over the mound to be cut off and then a crowbar is driven into the base of the latter just over the cable in as near a horizontal position as possible. If the crowbar inclines downwards at too steep an angle, the cable, when cutting, bears against the crowbar instead of sliding beneath it, and the task of the oxen is made very much more laborious. While the team strains, a labourer holds the crowbar in position (Fig. 2), and the mound is cut through cleanly at its base (Fig. 3). In cases of the very massive mounds it was found necessary to swing the team of oxen from side to side while pulling, in order that the grinding effect of the cable on the mound could aid the cutting process. With mounds of this type it was often found that the oxen had to struggle for five minutes or more before the cable won through, but with the softer mounds, once purchase was obtained, the cable slid through in an almost effortless way.

Though animal traction is the ideal method for cutting through the mounds in areas of light to medium infestation (10 to 50 mounds

per morgen) where there is adequate resting time for the cattle when moving from mound to mound, in practice it soon became apparent that it would not be satisfactory for long in large areas of heavy infestation (70 mounds per morgen and upwards), especially where there was a goodly proportion of very large, hard mounds. In such areas the mounds are so closely set that the cattle rapidly become exhausted and fall off in condition at an alarming rate. Heavy use of the whip becomes necessary and even then the rate of progress tails off progressively and the method becomes not worthwhile. The effort called forth from the oxen is too great to justify the use of animal traction when large areas of heavily infested veld have to be cleared. To maintain the required rate of progress under such conditions, more teams of oxen will be required (and consequently more labour) so as to ensure frequent rests for the animals. This would in turn raise labour costs to the point where substitution of mechanical for animal traction would pay better.

To deal specifically with areas of dense infestation, mechanical traction was tested out on a 30-morgen block of heavily mound-ridden veld. The mounds were in general so closely set as to cut dead mileage travelled by the tractor down to a minimum, and sufficiently massive to justify its use. A tracked caterpillar-type tractor was selected for the purpose in preference to a wheeled type owing to its superior quick-turning ability which cuts down on dead mileage.

It was found that the tractor cut almost effortlessly through the most massive mounds, provided it maintained its momentum and swerved as the cable was taking the strain so as to add grinding effect to the cutting process. To ensure maintenance of momentum it was found necessary that the loop should be thrown over the mound and held in position with a minimum of delay. The crowbar thrust into the mound to guide the cable proved to be too cumbersome and time-wasting. Instead it was found that two labourers following the tractor and adjusting the loop could guide the latter to the base of the mound by foot until the cable gripped the mound. With a little practice this was accomplished with ease and the tractor could move from mound to mound without stopping. Owing to the superior power of the tractor, once the cable had gripped there was no fear of its slipping up from the base of the mound. Hence the crowbar as used with animal traction became redundant.

Recommended Procedure for *Trinervitermes* Eradication.

The recommended procedure for *Trinervitermes* eradication decided upon after the Koffiefontein tests is as follows:—

All mounds, inhabited or deserted, must be cut off at their junction with the soil and fragmented in the surrounding veld. The subterranean portions of all inhabited mounds must be fumigated with medium solvent naphtha at a dosage of from 2 to 7 fluid ounces (average 5 ozs. per mound) and the cut surfaces thereafter covered with soil to confine the fumes in the nest systems. Mounds under 6 feet in basal circumference should be removed by bushpick and fragmented, while the larger mounds with a circumference of 6 feet and upwards should be shorn off at ground level by the traction method prior to, and to speed up, fragmentation. In lightly infested areas with mound densities of up to 50 per morgen, animal traction should be used so as to obviate expensive dead mileage, but in extensive heavily infested areas, especially where the proportion

of large, massive mounds is great, a caterpillar-type tractor should be substituted for the animals.

To economize on labour, a tap should be fitted to the naphtha drum in use, and the drum mounted on a wheeled chassis drawn by donkeys. Alternatively, the naphtha should be decanted into, and drawn from the taps of, a watercart. By this means the bulk fumigant follows the labourers and a minimum of time and labour is wasted in obtaining supplies for use

The labourers doing mound fragmentation and the fumigation should work in groups of 3, two with picks and spades to fragment the mounds, clear the cut surface for fumigation and cover the latter with soil after treatment, and the third to maintain supplies of fumigant and to apply it to the nests. By alternating rôles, each labourer in turn has a spell of the more restful task of fumigator, and a more sustained effort is possible. Each group should work along a definitely allocated strip to ensure treatment of all the small, easily missed mounds.

With three groups of three labourers working at mound fragmentation and fumigation they are able in fairly lightly infested veld to keep pace with one team of oxen doing the cutting. But in areas averaging 100 mounds per morgen of which 43 per cent. are over 6 feet in basal circumference, cutting by tractor averages out at 30 morgen per day or twice the working rate of the same labour force. If mounds are cut many days before they can be fragmented, the danger exists that they will once more be cemented to their pedestals. It is thus advisable to cut each day only as many mounds as can be coped with by the labourers following on afterwards. In heavily infested areas it is thus recommended that the tractor should work for only half the day, the three labourers on this work being diverted for the rest of the day to mound fragmentation and fumigation. In this way it will be possible to treat completely 15 morgen per day.

Cost of Recommended Treatment.

It is not possible to lay down any definite cost per morgen of the recommended treatment since too many variables affect the final figure. Such factors as mound density per morgen, the size and proportion of massive to small mounds, and the number of inhabited mounds per morgen all enter the picture and affect the costs of treatment.

Some indication can, however, be arrived at by an examination of the estimated costs of clearing 14,000 morgen of infested veld in the Koffiefontein district. The estimates in this case are based on detailed surveys and field-scale eradication experiments.

Of the 14,000 morgen, one-tenth was classed as heavily infested, where mounds of all sizes averaged 100 per morgen of which 70 were inhabited. This works out at a total of 140,000 mounds on 1,400 morgen of which 98,000 were inhabited. The remaining 12,600 morgen were classed as lightly infested with an average of 7 mounds per morgen of which 5 were inhabited—a total of 88,200 mounds of which 63,000 were inhabited. The estimates for the 14,000 morgen were thus 228,200 mounds to be fragmented down to soil level, including 161,000 of which the subterranean portions would in addition have to be treated with naphtha.

The whole area, lightly and grossly infested, could be cleared at a total estimated cost of £1,052. 6s. 8d. which averages out at

1s. 6d. per morgen. The work would take an estimated period of 7½ months to accomplish with the labour forces given above. The time taken could be halved by using two teams of oxen in lightly infested areas and one tractor working a full day in areas of gross infestation, but this would involve doubling the labour force, which in most areas would be an impractical proposition.

Against the cost of eradicating *Trinervitermes* infestations should be set the improvement of the veld which takes place as a result of spreading over it the fragmented material of thousands of mounds. These mounds are extremely rich in organic material which is unavailable to vegetal growth while bound up in mound form. The veld benefits by what virtually amounts to a top-dressing of humus-rich material. From observations made on the test plots at Koffiefontein where mound fragmentation had been applied, it was clear that reseeding of both grass and bush in the broken matrix was much higher than in the surrounding bare, windswept veld. After rain's had fallen, regrowth was also found to be much more speedy and luxuriant in spots fertilized in this way than elsewhere.

Conclusion.

Although eradication of *Trinervitermes* infestations is recommended as an integral part of veld reclamation in areas carrying peak infestations, all available data would seem to indicate that the money spent on it will be wasted unless subsequent grazing practice ensures as far as possible an adequate grass cover on the veld. With bad veld management subsequent to eradication it would seem most likely that, over a period of years, the termite population would once again build up to its previous levels.

The data given above have been extracted from a more detailed paper which is to be published shortly in pamphlet form by the Department of Agriculture.

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The Blackhead Persian:—

[*Continued from page* 83.

with Persian rams, the crossbred sheep yields an inferior type of hybrid wool, sometimes classed by farmers with merino wool—a practice which is most harmful to the good reputation of our South African merino wool.

Skins.

The skins of Blackhead-Persian sheep are known in the trade as Cape glovers and are very valuable. Skins are sold per piece and not per weight. During the past few years the price of undamaged skins rose to about ten shillings and more.

Great care should, however, be taken with the flaying and curing of the skins. For further information on the careful processing of skins, readers are referred to bulletin No. 263 " Preparation of skins for the market ", by Mr. P. D. Rose, Senior Lecturer in Sheep and Wool.

Hanepoot Grapes.

A. H. Malan, Western Province Fruit Research Station, Stellenbosch.

ALTHOUGH the Hanepoot grape with its delicious and delicate muscat flavour is usually preferred to other types of table grapes, at least in so far as the average South African consumer is concerned, this grape is unfortunately cultivated on a rather limited scale since, for its successful cultivation, it mostly requires special soil under climatic conditions, and moreover, possesses poor transport qualities.

Consequently, in dry, hot areas, on deep loamy soils under irrigation, where the Hanepoot thrives particularly well, e.g. along the Olifants River and elsewhere, it is cultivated practically exclusively for raisin production.

Treatment with Sulphur Dioxide.

The improved methods of treatment with sodium bisulphite or sulphur dioxide, have enhanced the potentialities of Hanepoot grapes on the local as well as the oversea market. Furthermore, in

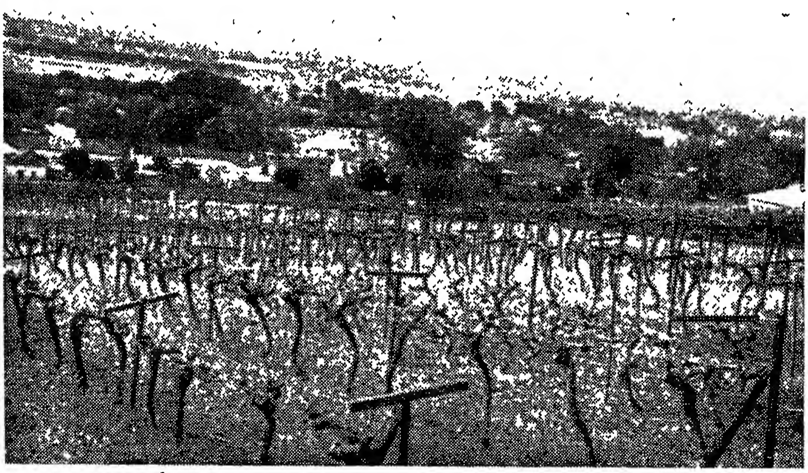


FIG 1.—General view of a Red Hanepoot vineyard on the Bellevue Experiment Farm at Paarl, where most of the experiments were carried out Various trellising systems are clearly visible with the overhead trellis in the background.

suitable areas, attention can be focussed on the cultivation of Red Hanepoot grapes, which, due to their attractive appearance have a higher market value. Generally speaking, the Red Hanepoot grape is more subject to millerandage (non-setting) and sun scald than the White Hanepoot.

On the basis of careful observations and results obtained in a number of individual experiments conducted at the viticultural experiment station at Paarl over a period of years, the following recommendations may be made for a more economic production of better-quality Hanepoot grapes.

Soil Requirements.

Deep, irrigable loamy soils situated in a dry and hot locality are usually suitable for the cultivation of Hanepoot grapes.

Weathered granite soils at least 2 to 3 feet deep, like those along the eastern slopes of Paarlberg, are also suitable and yield Hanepoot grapes with a good keeping quality which usually also show good colour development.

Shallow, poor and dry sandy soils or heavy potclay soils must be avoided as far as possible.

Selection of Scions.

With this variety more than with most others, timely marking in the vineyard of the parent vines and individual shoots to be used for grafting or propagation is important.

According to records, it appears that (in a certain percentage of Hanepoot vines) the qualities of good or poor fertilization do not remain constant, but vary from year to year according to the prevailing climatic and growth conditions.

FIG. 2.—Hanepoot vine. Two long bearers with 8 buds each, and the necessary short bearers have been left.

By commencing in time and keeping careful records of fertilization, vigour colour development, etc., for a few successive years, the poorer type of parent vine can be effectively eliminated. The farmer will be amply rewarded for his trouble by the elimination of a considerable percentage of poor vines.

Timely and thorough planning will greatly improve vine cultivation and should receive more attention and be applied as a general policy.

Rootstock.

Jacques with its good affinity can be used as a rootstock on soils suitable for Hanepoot, i.e. deep loamy soils which do not become dry during summer. If, owing to lack of sufficient irrigation water, the soil does become dry during summer, preference should be given to types like Richter 99, 333, 3306 or 143 B; for brackish soils 101-14 are recommended.

Winter Pruning.

Time of pruning.—In a variety such as Hanepoot which is often subject to poor fertilization, the time of pruning is most

important. Vines which fertilize well, i.e. those on which setting is good, may be cut back in July. Where millerandage (non-setting) is a frequent occurrence, it is advisable to prune late with the preliminary and final pruning performed in one operation from the second week in July up to the end of August.

Method of pruning.—It is well-known that Hanepoot is a regular bearer when spur or short pruning is applied and that the buds at the base of the shoot and those in the centre or towards the

FIG. 3.—The same vine as shown in Fig. 2, pruned with short bearers with 2 buds each.

tip of the shoot are equally fertile. Nevertheless, interesting data were obtained from a pruning experiment carried out for two successive years (1946 and 1947) on three rows of Red Hanepoot consisting of 20 vines each.

The following treatment was applied:—

A. *Long or Cane pruning.*—Two long bearers with 10 buds each, with the necessary short bearers. The long bearers were not bent.

B. *Long or Cane pruning.*—Two long bearers with 10 buds each, with short bearers. The long bearers were bent at the base of the shoot and twisted around the wire. For the 1946 crop, the vines with this treatment had no short bearers, and were also severely suckered.

C. *Short or spur pruning.*—(Short bearers with two buds) Fig. 3.

During the two years preceding the experiment, viz. 1944 and 1945, records were kept of the fertilization of all vines in this experiment, and the following results were obtained for the two years:—

TABLE 1.—(1944—1945.)

Row.	Percentage of well-fertilized vines.	Percentageof average vines.	Percentage of vines subject to millerandage.
1...........	52·0	32·5	15·0
2...........	27·5	57·5	15·0
3...........	10·0	50·0	40·0

The results obtained with this experiment during 1946 and 1947 were as follows:—

TABLE 2.—(1946.)

Row.	Treatment.	1st grade.		2nd grade.		3rd grade.		4th grade.		No. of bunches.	Total weight (lb.)	Average weight per bunch (oz.)*
		No. of bunches.	Weight. (lb.)	No. of bunches.	Weight. (lb.)	No. of bunches.	Weight. (lb.)	No. of bunches.	Weight. (lb.)			
1	A.....	86	154	57	69	72	65	24	14	240	302	20·16
2	B.....	67	98	68	80	70	58	40	23	245	260	16·96
3	C.....	76	111	49	51	83	64	45	19	253	247	15·68

TABLE 3.—(1947.)

1	C.....	158	272	60	65	52	44	42	17	312	398	20·48
2	B.....	154	251	57	62	73	60	25	12	309	385	20·00
3	A.....	171	288	51	49	70	54	26	13	318	404	20·48

* During 1947 treatment A was applied to row 3 and treatment C to row 1.

From the above data it would appear that long pruning may advantageously be applied to trellised Hanepoot vines provided that proper attention is paid to pre-thinning.

As stated above, fertilization of Hanepoot bunches from buds at the base of the shoot, is more or less the same as from buds in the centre or at the tips of the shoots.

Any advantage from long pruning must therefore be ascribed to the larger leaf surface in spring.

Although a larger number of bunches per vine were left in the case of the 1947 crop, the relative difference in yield as between the 1946 and 1947 crops, especially as regards the percentage of firstgrade grapes, is largely due to the fact that the vines for the 1947 crop were pruned later and the shoots thoroughly tipped on two occasions during the flowering period, i.e. all the extreme growing tips were pinched off or removed.

Topping of Hanepoot Vines.

Time of topping.—This experiment was carried out on Red Hanepoot vines. The treatment was applied to 10 vines and repeated three times. The crop was thinned to 10 bunches per vine after the flowering period.

The object of the experiment was to make a comparison between two groups of treatments, viz., topping before, during and after the flowering period and topping during and after the flowering period.

Moderate topping was applied before and after the flowering period with more severe topping during the flowering period on the following dates:—

A.

(1) 23 October 1942 }
(2) 30 October 1942 } Before flowering period.
(3) 9 November 1942—Flowering period.
(4) 2 December 1942—After flowering period.

B.

(1) 2 November 1942—At beginning of flowering period.
(2) 2 December 1942—After flowering period.

In accordance with actual practice, only the longer shoots were topped in all cases.

TABLE 4.—(*Average of* 3 *repetitions.*)

Treatment.	Select grade.		Choice grade.		Standard.		No. of bunches Total.	Total weight of select and choice grade. lb. ounces.
	No. of bunches.	lb. oz.	No. of bunches.	lb. oz.	No. of bunches.	lb. oz.		
A.........	19	20 0	22	17 11	68	29 0	109	37 11
B.........	34	34 0	28	17 3	39	17 8	101	51 3

There are accordingly indications, pointing to the advisability of topping Hanepoot vines for the first time at the beginning of the flowering stage. Where there is danger of damage by wind, care must be taken to fasten the shoots of trellised vines in good time, whereas in the case of untrellised vines, it may be advisable to top before the flowering period.

FIG. 4.—The Hanepoot vine shown in Figs. 2 and 3, *before* pruning. The shoots of this vine were only tipped during the preceding summer. Note the large extensive leaf development of the vine. In long pruning, short bearers are also necessary, since the shoots from the lower pair of buds on the long bearer usually develop poorly, as is clearly visible on the photo.

Method of topping.—There is a distinct similarity between Hanepoot and Alphonse Lavallée as regards vigour, bearing capacity, fertilization of the bunches, colour development, etc.; consequently, certain practices recommended for Alphonse Lavallée may advantageously be applied to Hanepoot, and vice versa.

In a five-year topping experiment* on Alphonse Lavallée at the Viticultural Experiment Farm in Paarl, it was found that thorough tipping of the shoots (i.e. the simultaneous removal of all the growing tips) during flowering time, and three subsequent tipping treatments (less severe if the soil is poor) not only considerably

* See "Farming in South Africa", September, 1945. Experiments on the topping of vines.

improved the quality and quantity of the crop, but also enhanced the fertility of the vines.

This tipping treatment has been most successfully applied to Hanepoot vineyards.

The results of the following experiment show the great advantage obtained with combined topping and tipping during the flowering period in contrast with a control or no topping.

The experiment was carried out in 2 rows of Red Hanepoot consisting of 40 vines each.

Treatments.

Row 1.—Control (No topping).

Row 2.—Thorough topping at the commencement of the flowering stage, followed by tipping of all shoots 8 days later.

TABLE 5.

Row.	1st grade.		2nd grade.		3rd grade.		4th grade.		Total No. of bunches.	Total weight lb.
	No. of bunches.	lb.	No. of bunches.	lb.	No. of bunches.	lb.	No. of bunches.	lb.		
1...	46	67	70	75	158	121	121	44	395	307
2...	162	296	133	170	73	60	32	13	400	539

The bunches were thinned out to 15 bunches per vine before the flowering period, and finally, to 10 bunches per vine after the flowering stage.

From previous observations and from results of this experiment, it is clear that millerandage can be considerably reduced by tipping all shoots of Hanepoot vines twice during the flowering period. In fact, the fertilization of the bunches is such that this practice can virtually be recommanded only in cases of severe millerandage, otherwise the bunches will be too dense.

There are two possible explanations for this phenomenon:—

(a) When the vines are topped for the first time at the commencement of the flowering stage, there is, as a rule, still a large percentage of bunches which will not flower for a considerable period and on which the first topping will have only a very slight effect, if any at all.

(*b*) The tipping, eight days later, enables the berries of these bunches to set well.

Suckering or breaking away of excessive Water Shoots.

When the vine is pruned during winter the equilibrium between the development above and below the soil is somewhat drastically disturbed; consequently, every normal vine produces a large number of shoots annually to restore this equilibrium.

A certain percentage of these shoots sprout from buds on perennial wood and are known as water shoots. These shoots bear few grapes and although they also contribute to the development of the vine and the crop, they nevertheless utilize valuable plant nutrients. Early removal of most of these water shoots will make more plant nutrients available to the remaining shoots. As a result, hotter and drier conditions will be created around the bunch during the flowering period which, in so far as fertilization, colour development and general health of the vine is concerned, may be most beneficial especially to luxuriantly-growing vines.

A large and adequate leaf surface is an important factor in the successful cultivation of Hanepoot grapes, and although the breaking away or suckering of water shoots may be advantageous, it should be carried out judiciously. Do not sucker Hanepoot too severely.

Removal of Leaves.

If the leaves immediately surrounding the bunch are broken off in good time, the bunch is gradually exposed to sharp light and sunshine. Damage from scald and abrasion is reduced, and colour development is promoted. It also serves as an indirect control measure against oidium, anthracnose and even mealy bug, especially in luxuriantly-growing vines.

As opposed to this, it must be borne in mind that the bottom leaves on the shoot, i.e. the oldest, are very valuable for the development of the berries. In practice it will be observed that normal development of the berries will be impaired if too many leaves are broken off. Aim, therefore, at breaking off the minimum number of leaves.

For promoting colour in Red Hanepoot, the breaking away of the leaves may be postponed until grapes have begun to change colour and the danger of scald damage has subsided.

Pre-Thinning of bunches.

In practice, the surpulus bunches are usually removed after the flowering period when differentiation is so much easier.

On the Victicultural Experiment Farm at Paarl, experiments on thinning *before* as against *after* the flowering period, were carried out on both White and Red Hanepoot grapes. In both cases the difference was negligible. In the White Hanepoot experiment, 4 rows of 40 vines each were used. In 1943 the surplus bunches in rows 1 and 3 were thinned out *before* the flowering stage and those from rows 2 and 4 *after* the flowering stage. The experiment was repeated in 1945 but in the reverse order. The total number of bunches included in the experiment was 2001 and 2003, respectively.

TABLE 6.—(*White Hanepoot*) *Thinning of surplus bunches. Collective results for 2 years.*

Treatment.	1st Grade.		2nd Grade.		3rd Grade.		Total No. of bunches.	Total weight	Average weight bunch lb.	Percentage Grade 1 grapes	Percentage Grade 2 grapes.
	No. of bunches.	Weight lb.	No. of bunches.	Weight lb.	No. of bunches.	Weight lb.					
Thinning *before* flowering stage.	540	940	408	464	888	556	1,836	1,956	1·06	47·9	23·7
Thinning *after* flowering stage.	676	1,024	500	548	984	568	2,160	2,140	0·99	47·8	25·5

In thinning out the surplus bunches of Red Hanepoot, 2 rows of 40 vines each were used. The bunches in row 1 were thinned to 10 bunches per vine on 15 November, 1946, *before* the flowering period whereas the bunches in row 2 were thinned to 10 bunches per vine on 4 December 1946 *after* the flowering period.

TABLE 7.—*(Red Hanepoot) Thinning of surplus bunches.*

Treatment.	1st Grade.		2nd Grade.		3rd Grade.		4th Grade.		Total No. of bunches.	Total weight.	Percentage Grade 1 grapes.	Percentage Grade 2 grapes.
	No. of bunches.	Weight (lb.)	No. of bunches.	Wei- (lb.)	No. of bunches.	Weight (lb.)	No. of bunches.	weight (lb.)				
Thinning *before* flowering stage...	163	264	83	82	100	64	54	20	400	430	61·4	19·1
							(Average weight per bunch : 1·97 lb.)					
Thinning *after* flowering stage...	168	269	92	92	90	66	31	17	381	444	60·6	20·8
							(Average weight per bunch : 1·16 lb.)					

According to data obtained from this experiment as well as from the preceding experiment on White Hanepoot, it may be assumed that there is probably no significant difference as between the two practices.

Since, however, selection is possible with the thinning of bunches after the flowering period, it is clear that the removal of surplus bunches before the flowering period will improve the fertilization of the remaining bunches.

It is therefore recommended that some of the bunches be removed before the flowering period (when the operation is easy) leaving about 3 or 4 more than the necessary number when they are finally thinned out after the flowering period.

Number of Bunches per Vine.

The optimum number of bunches per vine, or unit area of any variety is necessarily determined by the following factors, viz. soil fertility, fertilization, irrigation facilities, espacement, trellising system, size of the bunches and the condition of the individual vines.

With the exception of certain types of Hanepoot, e.g. the le Roux Hanepoot, which sometimes bears few and small bunches, rather drastic thinning is, as a rule, necessary even with short pruning. Crops which are out of proportion to the bearing capacity of the vine are not only detrimental to the constitution of the vines, but also give rise to, or aggravate various physiological defects such as poorly-developed bunches with small berries, tardy ripening of the grapes, insufficient colour in Red Hanepoot, and wilting of the berries during hot weather.

Although it is necessary for every farmer to make his own observations, it may be recommended, as a general guide, that on reasonably fertile soil which does not become dry in summer, each Hanepoot bunch on a small type of trellis requires an area of approximately 3½ to 4 sq. ft. of soil. In practice this means that with an espacement of 8 ft. × 5 ft., approximately 10 to 12 bunches per vine must be left (or 15 to 17 bunches on a slanting trellis) with an espacement of 6 ft. × 10 ft.

It must again be emphasized that these numbers will vary considerably according to the prevailing conditions.

Breaking off the Tips of Bunches.

An experiment on the breaking off of the tips of bunches was carried but on two rows of Red Hanepoot consisting of 40 vines each. The following treatments were applied:

Row 1.—Tips of bunches broken off at the beginning of the flowering period.

Row 2.—Tips of bunches not broken off.

The bunches were thinned out to 15 bunches per vine *before* the flowering stage and to 10 bunches per vine *after* the flowering stage.

FIG. 5.—A well-fertilized bunch of Hanepoort grapes.

TABLE 8.—*Breaking off of tips of bunches before and after the flowering stage.*

Row.	1st Grade.		2nd Grade.		3rd Grade.		4th Grade.		Total No. of bunches.	Total weight.	Percentage 1st Grade (Weight).
	No. of bunches.	Weight (lb.)	No. of bunches.	Weight (lb.)	No. of buncehs.	Weight (lb.)	No. of bunches.	Weight (lb.)			
1....	168	255	77	73	101	73	52	15	398	416	61·3
2....	118	204	96	111	112	88	62	22	388	425	48

Tipping at the beginning of the flowering stage is already becoming a fairly general practice. The results of this experiment once again prove that as far as the quality of grapes is concerned, tipping may be resorted to with advantage.

Thinning of berries.—Early thinning of Hanepoot bunches is essential to the production of grapes of outstanding quality. The extent of thinning depends on the firmness of the bunch; in some bunches the berries are loose either naturally or because of millerandage, while others again may be particularly firm, especially if the shoots are tipped twice during the flowering period.

Thinning has the following advantages: the remaining berries develop better, their colour is more attractive and wilting during very hot weather is less marked.

Experiments are under way in connection with the thinning of berries with a view to finding a more practical and economic method.

System of Trellising.

The overheaad trellising system is recommended only for selected, fertile irrigated soils favourable to growth, fertilization and colour development in Hanepoot grapes. This system also gives the highest yields per soil unit. Generally speaking, however, the slanting or fish-spine trellises will be more profitable, since the shoots are within easy reach and can be topped during the flowering period and millerandage thus reduced. Moreover, the bunches are also exposed through the slanting crosspieces of the slanting trellis to the beneficial rays of the rising sun which promote colour formation and the drying of the bunches after rain, and reduce fungus diseases such as oidium and anthracnose.

Irrigation.

Sufficient irrigation is a very important factor in the successful cultivation of Hanepoot grapes for, although a dry and especially a hot summer is favourable for the following crop, the existing crop may be a failure owing to the drought. The vines should be irrigated thoroughly at least once or twice, depending on the rainfall. In the western Cape Province irrigation should be applied at about the beginning of December and January.

It is important that the last irrigation should take place at least three weeks before the fruit is picked, otherwise the quality of the grapes may be impaired, the berries may become soft and watery and have a less delicate muscat flavour, and the transport and keeping qualities may be adversely affected.

Control of fungus diseases.

In the absence of proper precautionary measures, weather conditions conducive to anthracnose and oidium, may have a very adverse effect on Hanepoot grapes.

The following control measures are recommended for anthracnose and oidium:—

Anthracnose.—Winter spraying is of paramount importance. For this purpose a lime-sulphur solution (1 gallon in 8 to 10 gallons of water) *or* a copper-sulphate solution of 1 lb. in 1 to 2 gallons of water is used.

Spraying must be applied approximately three weeks before the vines sprout and must be thorough and wet all parts of the vine from the tips of the bearers to ground level. In summer the vines are thoroughly dusted with sulphur until all the green portions of the vine are covered with a thin layer of the dust.

Generally, the sulphur may be applied at the following times:—

(*a*) When the shoots have reached a length of 10 to 12 inches.

(*b*) When the vine has flowered.

(*c*) About three to four weeks after the second application.

If, at a later stage, conditions are favourable for infection, further applications may be made. Rainy weather during spring is particularly conducive to the spread of the disease.

Oidium.—Except for the winter spraying, the treatment is similar, the vines being thoroughly dusted with sulphur in summer at the same time as for anthracnose.

Insufficient applications are uneconomical since more are required, and the results are poorer.

Special attention should be paid to luxuriantly-growing vines on low-lying soils, since conditions for the development of the disease are very favourable here.

An application of sulphur after the crop has been harvested, may be very beneficial. Rapidly swelling berries are most susceptible to scald, and the applications, especially on the bunches, should be lighter.

Summary.

1. Cultivate Hanepoot on the right type of soil.
2. Apply careful selection when choosing shoots for grafting or planting purposes.
3. Prune late, carrying out preliminary and final pruning operations simultaneously and, if possible, during the second half of August, when necessary.
4. Prune long bearers of 6 to 8 buds and the necessary short bearers with 2 buds.
5. Remove the surplus bunches before the flowering period until there are a few more than the required number left, and apply final thinning when the fruit has set.
6. Tip all shoots for the first time at the beginning of the flowering period. Remove all the growing tips simultaneously. If necessary, repeat after 7 to 10 days.
7. Carefully and judiciously sucker or break off surplus shoots and leaves.
8. Break off the tips of the bunches.
9. Thin the berries in the bunches.
10. Trellis the vines properly.
11. Irrigate thoroughly, if necessary.
12. Control fungus diseases effectively.

LITERATURE.

(1) Sulphur for the control of Vine Diseases. S. J. DU PLESSIS. *Farming in South Africa* June 1943.

(2) Besproeiing van vrugtebome en Wingerde. P. E. LE ROUX VAN NIEKERK, *Die Wynboer*, Dec. 1946.

A New Bulletin.

Bulletin No. 284. The Feeding of Farm Animals (1. Dairy Cattle) has been published recently. It is obtainable from the Editor of Publications, Pretoria, at 3d. per copy.

An Analysis of Prices of Agricultural Commodities Since 1910/11.

A. J. du Plessis, Division of Economics and Markets.

IN 1936 the Division of Economics and Markets introduced a system of price reporting in all the larger centres of the Union, while about the same time prices for certain commodities also became available through the functioning of the Control Boards instituted under the Marketing Act of 1937. The data thus obtained enabled the Division to construct price indexes for the major agricultural commodities, and these have been regularly published in the Division's monthly bulletin, *Crops and Markets*, from 1936-37 onwards.

The Division, however, realized the necessity of having this series of farm prices available also for the period prior to 1936 and particularly for the period of World War I. It therefore set out to collect such prices. In this respect the Division was fortunate in locating a number of old records from which fairly representative prices for most agricultural commodities could be extracted for as far back as 1911.

The price indexes constructed from these data for the period 1911-12 to date have never been published in detail. The combined index for all the groups, however, appeared in the report of the National Marketing Council (1946), while in an article published in the July 1947 issue of *Farming in South Africa* Prof. F. R. Tomlinson of the Agricultural Research Institute, Pretoria, also used the combined index to illustrate agricultural price trends during the periods of the two world wars respectively.

In Table I the indexes for all the groups are now published for the first time.

From Table I it appears that after the outbreak of war in 1914 prices gradually increased, reaching a peak of 230 in the post-war year, 1919-20, largely as a result of the exceptionally high prices of wool, included in the group " pastoral products ".

In the following year the prices of nearly all commodities fell, particularly for the group " pastoral products ", which dropped from 263 to 83 as a result of the collapse of wool prices, while the combined index declined to 149. The following year, 1921-22, the combined index receded still further, to 102, but thereafter recovered and remained on a fairly stable level until the world depression set in in 1929. During the depression farm product prices declined severely, reaching a low level of 66 in 1932-33. Thereafter, due partly to the abandonment of the gold standard by the Union in December 1932, and partly to the widespread droughts in 1933, prices recovered sharply and the combined index rose to 107 in 1933-34. In 1934-35 the index was down again to 86 and although it moved up to 106 in 1936-37, it again receded to 93 in 1938-39. From 1939-40, however, under the influence of war-time circumstances, prices have continued to advance steadily, reaching the high level of 198 in 1946-47.

Comparing the peak seasons of the two post-war periods, i.e. 1919-20 and 1946-47, it appears that except for the groups " summer cereals ", " other field crops " (i.e. potatoes, sweet potatoes, onions and dry beans) and " slaughter stock ", the indexes of prices for 1919-20 were in all cases higher than for 1946-47. This is due mainly

to the degree of price control exercised during the latter period. Without such price controls prices during the present period would probably have exceeded the 1919-20 levels, as is actually the case in respect of the group " other field crops ", which largely includes uncontrolled products.

In reviewing the price indexes for the various groups during the depression period, 1929-30 to 1932-33, it appears that the prices of those commodities largely dependent on world markets, viz. maize and wool (included in the groups " summer cereals " and " pastoral products " respectively), receded the most. On the other hand, wheat prices (included in the group " winter cereals ") showed the least decline due to the fact that the home market for wheat was well protected during this period.

Relationship between Agricultural and non-Agricultural Prices.

The prices of farm products do not, however, present a complete picture of the farmers' economic position. The prices farmers have to pay are equally important. The relation of farm product prices to the prices of other commodities therefore affords a truer measure in this regard. Thus the purchasing power of farm products in terms of the wholesale prices of other commodities is presented in Graph 1. The method used to determine the purchasing power of prices for agricultural products was to express the combined index of prices given in Table I as a percentage of the wholesale price* index as published by the Office of Census and Statistics.

While agricultural prices rose markedly during World War I, the prices of other commodities rose even more rapidly, and, as is evident from Graph 1, the purchasing power of farm products declined. Only in 1919-20, the peak year for agricultural prices, was the position reversed and then only for that one year, since in 1920-21 and particularly in 1921-22 agricultural prices dropped to very low levels, whereas the index of prices for non-agricultural commodities continued to move upward. During 1922-23, however, agricultural prices recovered very rapidly and, except in 1925-26, remained on a relatively favourable level up to 1928-29.

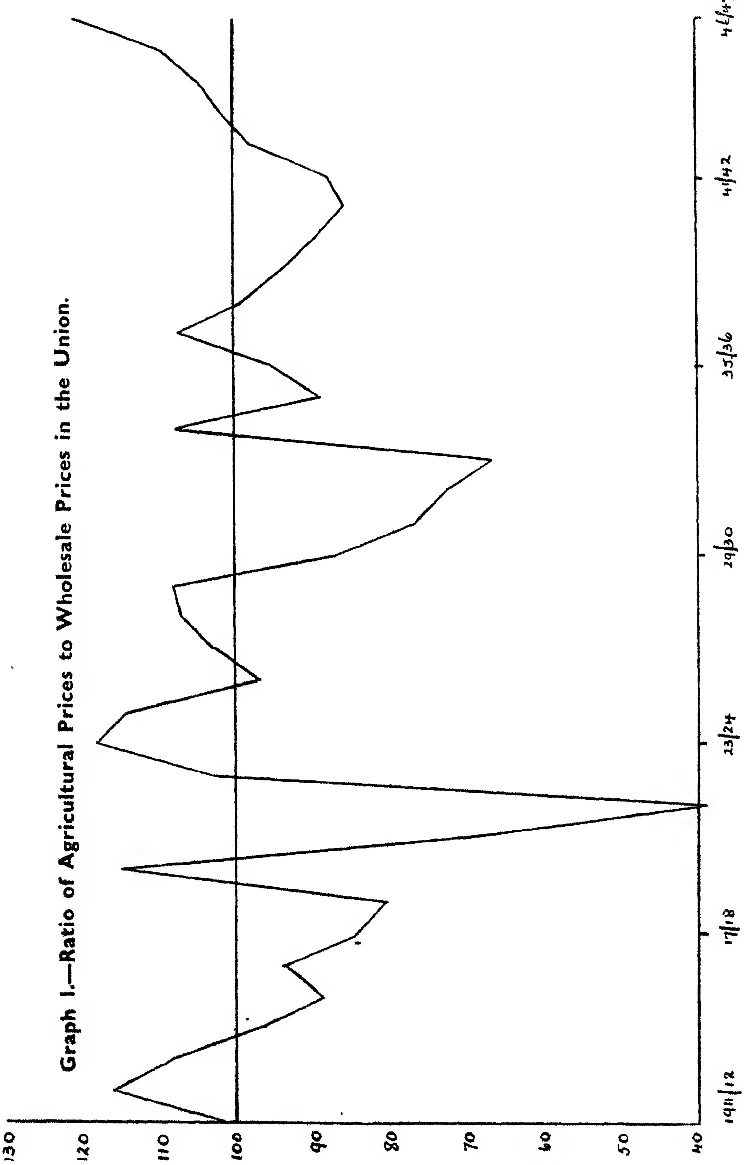
Since 1929, when the general depression set in, up to 1942-43 agricultural prices were below the level of prices of non-agricultural commodities, except in 1933-34 and 1936-37.

Not until 1943-44 did agricultural prices regain parity with the prices of other commodities. Since then the purchasing power of farm products has been reasonably favourable.

From the price indexes presented in Table I and the price relationship in Graph 1 it is evident that agricultural prices tend to rise and fall more sharply than non-agricultural prices during abnormal periods, e.g. during World War I and again during the depression. It is also evident that this tendency towards more violent fluctuations on the part of agricultural prices has been much less pronounced since the late thirties, i.e. from about the time the Marketing Act came into operation. In fact, one of the main objects of this Act has been to modify such violent price fluctuations and to effect a more stable relationship between the prices of agricultural and other commodities, which has been noticeably absent since 1928-29.

* For this purpose, the wholesale price index of the Office of Census and Statistics was recalculated on the basis of 1936/37 to 1938/39 to be comparable with the agricultural index, and some of the groups (consisting of agricultural commodities) comprising this index have been omitted.

Since World War I agricultural production in the Union has become more and more dependent on purchased agents of production (fertilizers, farm machinery, fuel, insecticides, etc.) and this tendency has definitely been very much accelerated since 1939. Thus, while prices of non-agricultural commodities (including farming requisites) increased more rapidly than agricultural prices



Graph I.—Ratio of Agricultural Prices to Wholesale Prices in the Union.

NOTE.—The index of agricultural prices is expressed as a percentage of the corresponding wholesale price index for each individual year, (i.e., the purchasing power of agricultural prices in terms of wholesale prices).

during World War I, the effect on agricultural was less serious than would be the case with a similar development under present conditions. Agriculture before 1920 was of a very extensive nature, cash labour wages and interest on borrowed capital comprising the bulk of the farm cash expenses, while the use of purchased farming requisites was negligible as compared with the present position.

Any appreciable decline in the present level of farm product prices relative to the prices of non-agricultural products would therefore affect the farming community even more seriously than was the case in earlier periods, with more severe repercussions on the economic position of farmers, resulting in further depletion of soil fertility and a lowering of rural standards of living.

Any serious decrease in industrial employment, with the resultant decline in purchasing power, tends to exert an undue pressure on agricultural prices. This is all but a reassuring fact in view of the traditional tendency for farm product prices to decline more rapidly than the prices of other commodities during periods of recession.

While it is anticipated that the present marketing and price control measures in agriculture can be sufficiently developed to maintain a reasonable balance between farm product prices and other prices under such adverse circumstances, the Control Board system should not be regarded as a complete and only safeguard to producers against all economic disturbances. The primary responsibility still remains with the individual producer to rationalize his farming business, to organize it so as to be most efficient, to reduce production costs as low as is possible under existing intensive conditions, and at the same time to conserve the soil fertility.

TABLE I.—*Index of prices of field crops and animal products.* (*Basis* 1936-37 *to* 1938-39=100: *July-June.*)

Year.	Summer cereal.	Winter cereal.	Hay	Other field crops.	Pastoral products.	Dairy products.	Slaughter Stock.	Poultry and poultry products.	Combined index.
	Weights.								
	(*a*) 19	(*b*) 13	(*c*) 2	(*d*) 3	(*e*) 34	(*f*) 6	(*g*) 17	(*h*) 6	100
1910–11	..	..	..	..	..	..	..	..	..
1911–12	98	91	112	133	60	103	94	200	91
1912–13	116	109	146	139	66	110	106	192	102
1913–14	92	117	126	129	70	105	97	193	97
1914–15	86	145	125	124	64	112	94	172	96
1915–16	75	160	114	128	79	125	107	165	104
1916–17	116	173	142	136	127	117	107	183	131
1917–18	116	171	116	129	152	125	135	187	144
1918–19	117	163	153	158	150	134	147	206	148
1919–20	210	225	282	215	263	232	179	253	230
1920–21	186	201	173	208	83	169	141	260	149
1921–22	99	137	132	118	78	105	91	182	102
1922–23	125	123	116	142	141	119	100	167	128
1923–24	121	122	131	156	169	151	101	178	141
1924–25	145	141	114	125	182	117	104	184	150
1925–26	111	144	109	124	127	119	95	176	123
1926–27	135	134	147	159	127	118	97	165	127
1927–28	114	134	116	139	141	146	96	150	128
1928–29	127	126	108	126	131	151	101	143	126
1929–30	112	110	79	97	85	109	87	136	98
1930–31	70	108	85	99	70	106	76	117	82
1931–32	76	110	86	109	48	91	64	99	72
1932–33	53	99	90	87	52	82	62	92	66
1933–34	119	102	109	113	107	104	91	126	107
1934–35	79	103	93	91	73	92	90	118	86
1935–36	83	92	95	100	99	83	86	106	92
1936–37	119	86	95	93	122	86	89	102	106
1937–38	89	105	112	118	99	112	105	107	101
1938–39	92	109	96	89	79	102	106	94	93
1939–40	86	114	77	95	115	105	106	89	104
1940–41	108	120	106	156	102	108	110	103	109
1941–42	120	144	143	203	102	131	135	136	124
1942–43	160	157	144	159	122	147	168	167	147
1943–44	170	186	137	212	122	154	185	188	159
1944–45	183	186	160	281	122	177	179	184	164
1945–46	201	194	164	312	118	198	185	170	170
1946–47	241	209	149	232	169	205	192	204	198

(*a*) Maize and kaffircorn.
(*b*) Wheat, oats and rye.
(*c*) Lucerne and teff hay.
(*d*) Potatoes, sweet potatoes, onions and dried beans.
(*e*) Wool, mohair, hides and skins.
(*f*) Butterfat, cheese and condensing milk.
(*g*) Cattle, sheep and pigs.
(*h*) Fowls, turkeys and eggs.

Fusicladium of Apples.

V.—Control by Spraying.

Dr. A. J. Louw, Western Province Fruit Research Station, Stellenbosch.

IN the previous issue of this periodical, an article was published on the control of Fusicladium by the eradication of the sources of infection. It was pointed out that, while such methods may definitely be of value, they cannot be exclusively relied upon for the effective control of the disease and that at most, they are of value only as a supplement to summer spraying.

The object of summer spraying is in the first instance, the prevention of infection, and not the wiping out of infection already present. It is of the utmost importance, therefore, that the different applications in the spraying programme should be so arranged that, in relation to the seasonal development of the tree, the maximum spray covering of the exposed leaf surface is maintained. The protective covering sprayed on the tree gradually loses its

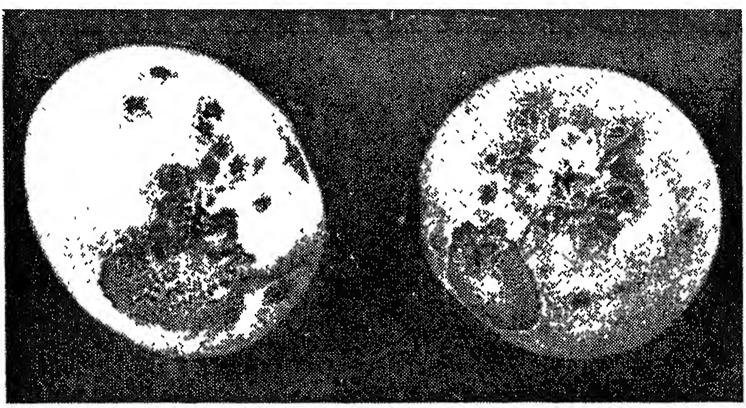


FIG. 1.—Apples infected with Fusicladium.

efficacy with the development of the leaves and fruit. As the latter swell, the particles of pray on the surface of the fruit are moved further apart; moreover, any new foliage naturally has no spray covering. In addition the spray is constantly washed from the leaves and fruit by rain.

Thus in drawing up a spraying programme for the control of Fusicladium, very important points to consider are the timing of the applications according to the rate of seasonal growth of the tree and the durability of the spray film produced by the spray material. The effect of the spray on the tree and fruit should also be taken into account since the fungicide is also toxic to plants and is liable, therefore, to damage the tree and the fruit to a greater or lesser extent. It is further necessary to ascertain whether the fungicidal spray is compatible with other essential sprays such as those applied for the control of the codling moth.

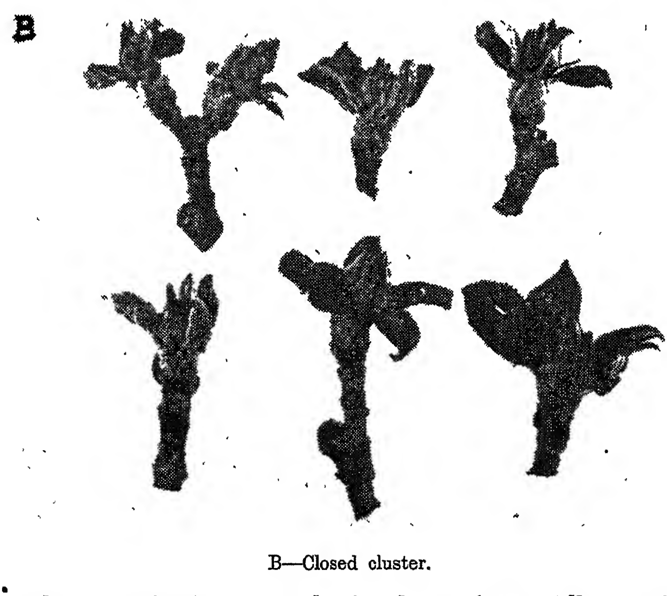
Spraying for the control of Fusicladium is timed according to definite stages in the blossom development of the apple tree. The critical stages for the winter-rainfall area are indicated in Figure 2.

When to Spray.

Spraying should start at the first signs of new leaf growth, i.e. when the buds are in the so-called "green-tip" stage [Fig. 2 (*a*)]. Timely spraying at this stage is very important for as yet no reserve

FIG. 2.—The different stages of blossom development in the apple tree according to which the spraying programme is arranged—
A—Green tip.

of spray material has been built up on the framework of the tree whereas the number of winter spores of the causal fungus is generally at its maximum and the climatic conditions are as a rule exceedingly



B—Closed cluster.

favourable for infection so early in the spring. All too often the first application is delayed because it is considered that not enough

leaf growth is exposed as yet to justify spraying. It should be borne in mind, however, that a single infection at this early stage can build up a much greater secondary source of infection in the

C—Pink bud.

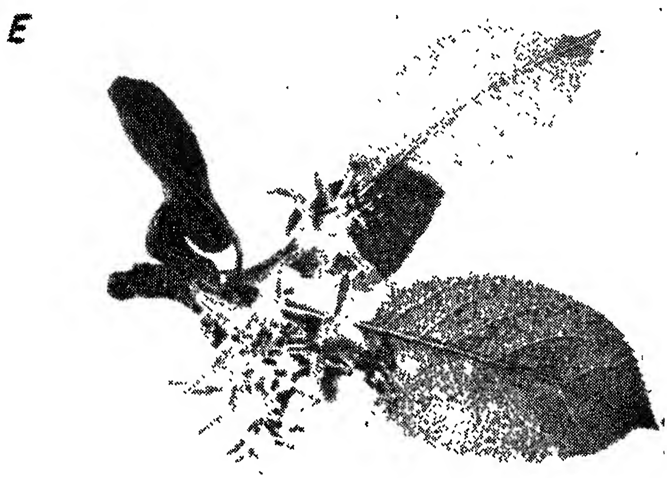
tree than subsequent infections—hence the extreme difficulty in achieving economic control of Fusicladium if the disease has not been successfully controlled in the early stages of bud development.

D—Full Boom.

The second application should follow when the majority of the blossoms have reached the " closed cluster " and " pink bud " stages [Fig. 2 (*b*) and (*c*)]. Generally, this development follows within 10 to 14 days of the " green tip " stage. At this stage a large leaf surface and also the sepals are already exposed to infection. As

pointed out in a previous article, infection of the sepals is fatal, since from the calyx the Fusicladium spores spread over the developing fruit, such fruits becoming so severely infected as to be entirely worthless. In the "closed cluster" and "pink bud" stages the sepals are still folded around the individual blossoms and they can be thoroughly covered with the spray on the outside. Later the tips of the calyx curl over, and their original outer surface can no longer be properly reached with the spray mixture.

The third application should coincide with the flowering stage, i.e. more or less when the majority of the blossoms have just passed the "full bloom" stage and the petals are beginning to drop [Fig. 2 (*d*) and (*e*)]. In this stage the calyces can be very thoroughly sprayed particularly if the petals have already dropped, and this application, like the second, is therefore of the greatest importance for the protection of the developing fruit against infection. With this application, the stalks of the individual flowers can also be thoroughly sprayed as a precaution against their infection which frequently is the cause of the dropping of the flowers.



E—Calyx Stage.

The fourth spraying is applied when the fruit has set [Fig. 2 (*f*)], i.e. approximately three weeks after the third application; the main object of this application is to cover the young fruit with a protective film of spray material.

Which Spray to Use.

The choice of a spray presents a problem to fruit-growers. Admittedly, there are numerous commercial spray preparations available to-day. On a closer examination, however, it will be clear that in the winter-rainfall area the apple grower's choice is very limited.

The well-known Bordeaux mixture and other copper-containing sprays all tend under humid conditions, to damage the leaves and fruit of apple trees [Fig. 3 (*a*) and (*b*)]. It is during these very conditions that Fusicladium thrives and it is also at such times that spraying is necessary. Consequently, this spray is sometimes liable to do more harm than the disease itself. For this reason,

copper-containing sprays are not recommended for Elgin and localities such as those on the mountain at Piketberg and Agter-Witzenberg in the Ceres district. Moreover, some apple varieties are exceptionally sensitive to copper. It is for instance never advisable to spray Ohenimuri apples with copper-containing mixtures, which, by injuring the epidermal cells, impart a very unattractive rough surface to the fruit. The keeping quality of such fruit is much poorer than that of fruit with a smooth surface.

F—Fruit Stage.

Another factor to be taken into account is the chemical reaction of the spray. Bordeaux mixture and, for that matter, most of the copper-containing commercial sprays have an alkaline reaction. These sprays cannot, therefore, be used together with "fixed" nicotine which is now in almost general use in the control of the codling moth. There are, however, some copper-containing sprays with a neutral reaction available in the trade to-day, which can be

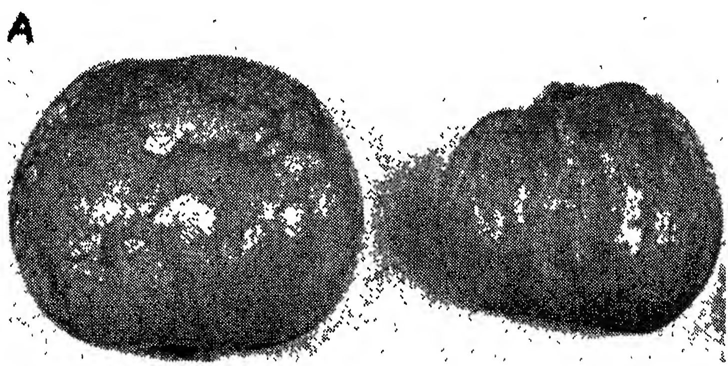
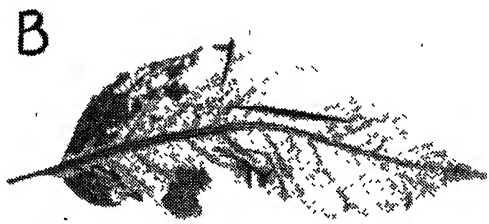


FIG. 3.—Various orms of scorcing which sometimes result from spraying for Fusicladium.
A—Fruit with a russeted surface caused by spraying with Bordeaux-mixture.

mixed with "fixed" nicotine. Unfortunately, most of these mixtures are inclined to damage the leaves and fruit of the apple tree. Compounds of the copper-oxy-chloride type have proved to be the safest as regards the incidence of this form of spray injury.

The sulphur-containing sprays such as lime-sulphur mixture and the wettable sulphur preparations may also cause scorching of the leaves and fruit, especially in hot weather [Fig. 3 (c)]. Another

disadvantage of the sulphur-containing mixtures is that they cannot be used together with oil emulsions. The simultaneous application of sulphur and oil sprays in summer may cause severe scorching of the trees and fruit.



B—Scorched apple leaf—the result of spraying with Bordeaux-mixture in wet weather.

Scorching resulting from lime-sulphur sprays may be greatly reduced by the use of weaker spraying mixtures without detracting from the economic control of Fusicladium. The sulphur in lime-sulphur mixture is present in a soluble form and is precipitated in very tiny particles on the leaves and fruit when the spray dries, thus covering the different parts of the plant much more thoroughly than when in suspension, as in wettable sulphurs. It is for this reason that lime-sulphur even when much diluted still affords satisfactory protection against Fusicladium.

C—Apple leaves with scorched margins caused by the application of lime-sulphur sprays in very hot weather.

Lime-sulphur has an alkaline reaction and, as stated above, such sprays cannot be mixed with "fixed" nicotine. Some of the wettable sulphur preparations, however, have a neutral reaction and can be used with "fixed" nicotine. A serious drawback of the wettable sulphur spray mixtures, however, is their very poor adhesion to surfaces onto which they are sprayed and the uneven covering provided on leaves and fruit. The protective action of the

wettable sulphurs is short-lived as they are very easily washed off by rain. Thus in times of heavy rains the wettable sulphur mixtures generally do not afford satisfactory control of Fusicladium..

Conclusion.

From the above it is clear that the choice of a spray for the control of Fusicladium will depend on the apple variety, the geographical situation and the spraying programme applied for the control of the codling moth.

For the grower who still uses only lead arsenate for the control of the codling moth pest, the choice is not a difficult one. He can use either of the two approved fungicides, Bordeaux mixture or lime-sulphur—depending on which of these will, under his specific conditions, produce the minimum of scorching.

In the case of copper-sensitive apple varieties and in localities where copper-spray injury is liable to occur, growers will have no other option but to use sulphur-sprays. Such growers will have to limit themselves entirely to lead arsenate or "fixed" nicotine for the control of the codling moth, oil emulsions being completely precluded from the spraying programme. Further it is always advisable to give preference to lime-sulphur, as it affords a more lasting covering than wettable sulphur. Where, however, wettable sulphur has to be used, e.g. to fit "fixed" nicotine into the spraying programme, its application should be confined to the post blossom period of the apple tree after at least two applications of lime sulphur have been applied. It should be remembered that the efficacy of spraying against Fusicladium will decrease with the substitution of wettable sulphur for lime-sulphur. Where Fusicladium presents a serious problem, it would be advisable to use lime-sulphur for at least the first three applications, and then to adapt the codling-moth spraying programme to this by continuing to spray with lead arsenate in the calyx stage.

Where the use of copper-containing remedies does not result in excessive losses from scorching, the problem is greatly simplified. In such cases one of the neutral copper-oxy-chloride compounds, several of which are available in the trade, may be used. Any of the usual codling moth spraying programmes may be adapted to these.

The various spraying measures for the control of Fusicladium may be sumarized as follows:—

Time of Application.	*Spray mixture.* (The figures in parenthesis denote the quantities per 100 gallons of water.)
1. Buds in "green tip" stage.	Lime-sulphur mixture (1¼ gallon)* or Bordeaux mixture (10 lb.)†
2. Buds in "closed cluster" to "pink bud" stage.	Lime-sulphur mixture (1¼ gallon) or Bordeaux-mixture (10 lb.) or copper-oxy-chloride (5 lb.), the latter where oil sprays are to be used for the codling moth.
3. Blossoms in "full bloom" stage up to the fall of the petals, or the so-called calyx stage.	Lime-sulphur mixture (1¼ gallon) or Bordeaux mixture (10 lb.) or copper-oxy-chloride (5 lb.); the latter where oil sprays are to be used for the codling moth, or *a neutral* wettable sulphur (5 lb.) where fixed nicotine is to be used for the codling moth.

* Calculated for lime-sulphur mixture of 32 per cent. poly-sulphide sulphur.

† Or home-made Bordeaux mixture in the radio of 5 lb. copper sulphate, 5 lb. lime ot 100 gallons of water.

4. Approximately three weeks after the calyx stage.	Lime-sulphur mixture ($1\frac{1}{4}$ gallon), or Bordeaux mixture (10 lb.), cr copper-oxy-chloride (5 lb.); the latter where oil sprays are to be used for the codling moth, or a *neutral* wettable sulphur (5 lb.) where fixed nicotime is to be used for the codling moth.

In conclusion, it should be pointed out that a spraying programme as outlined above can serve as a guide only, and that it may sometimes be necessary to effect certain amendments with a view to adapting the programme to specific weather conditions.

In some years trees are inclined to bud unevenly, with the result that all the different stages of blossom development may be found simultaneously and over a long period on the same tree. In such cases it might be necessary to include a special application before the flowering stage. Abnormal rains may wash the spray from the tree to such an extent as to leave the foliage and fruit with insufficient protection until the next application; in such cases a timely additional application may be advisable.

The mode of application of the spraying programme in practice is also of paramount importance. An application is often postponed when the weather is threatening, it being argued that the rain will wash the spray from the trees. Nothing is more calculated to reduce the efficacy of a spraying programme than such an argument. On the contrary, it is always a sound policy to aim at getting the sprays on ahead of general rain periods, for it is during such rainy spells that infection sets in.

Supply of Tobacco Seed by the Department:—

[*Continued from page* 76.

In future all orders should be placed with: The Officer in Charge, Agricultural Research Station, P.O. Box 213, Rustenburg.
Cash should be sent with the order as no seed is supplied C.O.D. Postage stamps cannot be accepted and only orders of quantities in full ounces will be executed. It will expedite matters if orders for seed are accompanied by postal orders or cheques. It is not necessary to add exchange on cheques.

Arrangements are being made with tobacco co-operative societies to sell seed direct to their members. You can therefore approach your society for the necessary seed.

All seed is cleaned and sterilized before despatch. Further treatment of seed on the farm is therefore unnecessary.

It will be appreciated of the names and addresses accompanying orders are written legibly and fully.

Should the grower be uncertain about the variety to be grown and the choice of variety left to the supplier of seed, full particulars with regard to soil type, soil fertility, type of tobacco, etc., should be submitted.

Approximately 1 ounce of seed is required for each morgen of tobacco to be planted.

The Horse on the Farm:—

[Continued from page 96.

a heat period may be dispensed with and the stallion's energy conserved. Before this can be done, however, it is necessary to know the heat period of one's mares and this can only be done by frequent teasing (every second day) until these facts have been ascertained.

Mares usually come into heat about seven or eight days after foaling, and this heat period is shorter than the following heat periods, averaging three days, although slightly shorter and slightly longer heat periods are met with.

Mention has been made of anoestrus of sexual quiescence into which mares go in the winter. This period may be prolonged in a late, droughty spring.

Feeding and Fertility.

During a dry spring with no fresh green grazing it is often found that mares do not show oestrus. Even a little bit of green feed during this period and some time prior to mating has a tremendous influence on the fertility of both stallion and mare and the breeder should make every effort to secure the essential supply of green feed. This is practically possible everywhere where a small stud of choice animals is maintained.

A good assurance toward raising the fertility level in horses is the provision of a quart or two of rolled or cracked wheat, pollard or wheat middlings, or even bran with rolled oats, some time before the breeding season, and even after if other feeds or grazing are not of high quality.

In the extensive ranching type of stud such attentions are not possible and one has to rely on chance—often very much to the detriment of the stock and the owner. It is the stud in which every unit counts for highest efficiency and value that helps to maintain the high standard of a country's horse stock. With dwindling horse populations all over the world, the misfits and badly-bred horses are ending up in brine, tins and bonemeal so that fewer but better animals can find a worthy place in the progressive and prosperous ways of life of the country.

Please Note.

"Duck Farming", Bulletin No. 248, which was out of print for a time, has been reprinted and is now obtainable from the Editor of Publications, Pretoria. Price 6d. per copy.

"Poultry Farming", Bulletin No. 241, and "Nutrition of Poultry" are out of print and will be reprinted. An announcement will appear in this journal when stocks are available again.

The Farm Home.

(A section devoted mainly to the interests of Farm Women.)

Mealie Products.

Miss Joyce de Jong, Home Economics Officer, Department of Agriculture.

THE mealie has a large reserve supply of substances suitable for human consumption and is the staple food of millions of natives in this country. All cereal products are palatable and, being a cheap source of energy, of great economic value. Mealies, in particular, can be easily cultivated, handled and transported. If stored in the dry form, mealies will keep well.

Composition.

There are many types of mealies, viz. white, yellow, red, soft and sweet mealies, to mention only a few. The latter type grows very rapidly, but needs much rain during the growing season.

The mealie kernel consists of a hard, fibrous outer covering with a gluten layer underneath. The starchy cellulose is situated in this layer, comprising 4/5 of the whole kernel. The gluten layer is rich in phosphorus and protein. The composition of mealies (whole and in the form of meal) is as follows:—

	Whole mealie. %	*Mealiemeal.* %
Water	10·95	12·57
Fat	9·88	7·13
Protein	4·7	1·33
Carbohydrates	71·95	78·36
Cellulose (crude fibre)	1·71	0·87
Ash or mineral salts	1·36	0·61

Mealies are richer in fat than in proteins, and deficient in mineral salts. The most important proteins in mealies are zein and glutelin. The latter is one of the two constituents of gluten. The other constituent, viz. gliadin, is lacking, and that accounts for the absence in mealies of the resilient gluten, essential in a meal which is to be converted into a dough. Consequently, if a dough is to be made with mealiemeal, this meal is always combined with another type of meal containing sufficient gluten, for example, wheat meal.

Two methods of converting mealies into meal are employed to-day, viz.:—

(1) The mealies are placed in a dry kiln, and dried to facilitate the removal of the skin, destroy the germs and allow the moisture to evaporate.

(2) The mealies are ground to remove the bran and the germ. In this process a large portion of the gluten layer is also removed. By first soaking the kernels, however, it will be possible to remove the skin only.

Composition of the Mealie Kernel and its Various Parts.

	Percentage of Whole Kernel.	Protein.	Fat.	Carbo-hydrates.	Fibre.	Ash.
Kernel........	100·0	12·6	4·3	79·4	2·0	1·7
Husk.........	5·5	6·6	1·6	74·1	16·4	1·3
Germ.........	10·2	21·7	29·6	34·7	2·9	11·1
Cellulose......	84·3	12·2	1·5	85·0	0·6	0·7

N.B.—The skin is rich in fibre, the germ is rich in fat, protein and mineral salts, and the cellulose in carbohydrates.

The fat in mealies at normal temperatures is in a fluid state and is therefore called oil.

Mealie Starch.

The starch of seeds is in the food of the young plant. The grains of each species have a characteristic form and appearance which renders it easy to detect adulteration. The starch content of mealie-meal is 71 per cent. in comparison with 75 per cent. in wheat meal, 78 per cent. in ryemeal, 68 per cent. in oatmeal and 62 per cent. in buckwheat meal.

To extract the starch from mealies, the kernels are placed in a mixture of hot water and sulphuric acid to prevent fermentation and to loosen the cellulose. This allows of the kernels being ground without damage to the germ.

The germs are then washed, dried and pressed for the manufacture of mealie oil and mealie-germ cakes, which are used as feed. The residue starch is ground and sifted and the bran used as feed. The grains of mealie starch are round and arranged in a mass. The starch is used in laundries, or broken up by means of chemical processes into dextrin and maltose. Dextrin is used as a substitute for gum, or in photography; also for the dyeing of cotton or in the manufacture of paper, felt, ink, etc.

Mealie Oil.

After the germ has been obtained from the kernel it is dried and then pressed to separate the germ oil and germ meal. The oil is then neutralized, bleached and deodorized. It is of a light strawy colour and contains the glycerides of oleic, palmitic and stearic acid.

Food Products from Mealies.

Samp and Mealie Rice.—The cellulose of the kernel consists of two parts:—

(1) The outer portion in which the gluten and starch are mixed, and (2) the white starchy portion.

After the kernel has been softened, the outer covering removed and the germ loosened, coarse, starchy pieces remain, known as samp. This can be ground to mealie rice.

Mealiemeal.—The mealiemeal on the market is either white or yellow, the latter possessing a higher nutritive value, by reason of its vitamin A content. Samp, mealie rice and mealiemeal are various steps in the grinding of the mealie kernel.

Cornflour.—The starch portion is sifted and the sifted portion mixed with water and allowed to flow over large tables. The starch is allowed to settle and the remaining portion known as gluten liquid

is used for human food. The wet or green starch is used in the manufacture of glucose or mealie syrup or for the extraction of pure starch. It is then dried and ground and marketed in packets for use in the making of puddings and infant foods. Cornflour consists of 90 per cent. starch and 10 per cent. water, and being so inexpensive, is sometimes used in the adulteration of arrowroot and sago. Cornflour has twice the thickening properties of wheatflour, and must be cooked over direct heat for 3 to 5 minutes.

Mealie syrup.—By treating the cornflour with acids and hot steam, the starch is converted into syrup which is then neutralized, filtered, decoloured and the water evaporated until the solids content is 80 per cent.

Cornflakes.—These are rolled, toasted mealie rice. The commercial packets contain malted, cooked flakes to which sugar and salt have been added. No further cooking is necessary.

The composition of cornflakes is—

Water............	9·63%	Fibre........	0·57%
Proteins..........	9·21%	Fat*............ .	0·54%
Carbohydrates.....	78·31%	Mineral salts.......	1·74%

* Only a small amount is present. The fat present in the germ, is removed to prevent the product from soon becoming rancid.

One ounce of corn flakes has a caloric value of 100 and contains—

Proteins.......	2·1 grams	Phosphorus....	0·029 grams
Calcium........	0·004 grams	Iron..........	0·0007 grams

Mealies contain twice as much fat or oil as wheat, three times as much as rye, twice as much as barley and two-thirds as much as dehusked oats.

Their caloric value is 1,800 calories per lb.

In its raw form, cornflakes can be prepared by stirring 1 cup of flakes into boiling salt water (2 to 3 cups of water and 1 to 1½ teaspoons of salt) boiling the mixture over direct heat for 5 minutes and then placing in a double-boiler until done.

The Purchase of Cereals.

All types of cereals are cheaper if purchased in large quantities. Keep them free from dust and mite. If small quantities are used, it is advisable to buy them in packets. If bought loose, they should be stored in tins.

Table for Cooking of Maize Products.

Type.	Quantity.	Salt.	Water.	Period.	When cooked it gives.
Samp.........	1 cup	1–1½ teaspoons	4–5 cups (plus 1 tablespoon of shortening)	4–5 hours	4 cups
Mealie rice....	,,	,,	3–4 cups (plus 1 tablespoon of shortening)	1–3 hours	3 cups
Mealiemeal....	,,	,,	4–5 cups	½–¾ hour	4 cups

Stir the mealies in boiling water. The meal may be cooked directly over heat. Cooking has the following effects:—

(1) The cellulose becomes soft. (2) The starch is made soluble and is easier to digest since the action of the digestive juices on the

grains is facilitated. (3) A softer product with a better flavour is obtained.

Recipes.

Thin mealiemeal porridge.—Mix 1 cup of mealiemeal with a little cold water and stir the mixture into boiling salt water (quantity and period as indicated above).

Thick mealiemeal porridge (Putu-porridge or crumbly porridge)—Mix 4 cups of mealiemeal with 1½ cups of boiling salt water. Do not stir, and place the lid on the saucepan. Allow the meal to steam slowly for ½ an hour. Stir the meal which has by now swollen out. Crumbs will be formed. Allow to cook slowly for 1-1½ hours on the side of the stove.

CREAM OF MEALIE SOUP.

6 green mealies boiled in 1 pint of water for 10 minutes
2 cups of milk
1 slice of onion
1 sprig of parsley.
2 teaspoons of meal or 1 teaspoon of cornflour
2 teaspoons of butter
Salt and pepper

Heat the milk with the onion and parsley; melt the butter and stir in the meal, salt and pepper. Remove the mealies from the cob and rub through a sieve. Remove the onion and parsley from the milk and stir in the butter and meal mixture. Stir the fine mealies and boil. Serve with whipped sour cream.

GREEN-MEALIE CUSTARD.

3 cups of chopped or grated green mealies
2 eggs
1 teaspoon of salt
⅛ teaspoon of pepper
1 tablespoon of butter or fat
2 cups of milk

Beat the eggs slightly, add the other ingredients, pour into a greased baking dish and bake in a slow oven (325° F.) until set. (Sufficient for 10 persons).

GREEN-MEALIE SOUFFLÉ.

1 tablespoon of butter or fat
1 tablespoon of meal
½ cup of milk
2 eggs
1 teaspoon of salt
¼ teaspoon of paprica
⅛ teaspoon of pepper
2 cups of grated, fresh or canned mealies

Melt the shortening and stir in the meal. Add the milk and cook until smooth, stirring continuously. Add the seasoning, then the mealies and allow to cool slightly. Then add the well-beaten egg yolks and fold in the stiffly-beaten whites. Pour into a greased baking dish and place in a pan of hot water. Bake in a moderate oven until the egg has coagulated.

GREEN-MEALIE FRITTERS.

3 cups of chopped or grated green mealies
2 eggs
¾ cup of meal
¾ teaspoon of salt
⅛ teaspoon of pepper

Mix the ingredients and let the mixture drop from a spoon into a frying pan of hot fat. Fry until brown on the one side, turn and fry on the other side.

BLANC MANGE.

3 tablespoons of cornflour
2–4 tablespoons of sugar
½ cup of cold milk
1½ cups of heated milk
½ teaspoon of vanilla essence
A pinch of salt

Mix the cornflour and sugar with the cold milk and add to the heated milk. Cook over direct heat, stirring continuously until thick. This will take about 5 minutes. Add the salt and vanilla essence.

Pour into moulds which have been rinsed with cold water. When set, unmould and serve with cream or a chocolate sauce and a little sour jelly.

MEALIEMEAL GIRDLE CAKES.

1 cup of mealiemeal
1 teaspoon of sugar, if desired
1 teaspoon of salt
2 cups of boiling water
1¾ cups of milk
2 cups of unsifted meal
5 teaspoons of baking powder
2 eggs

Pour the boiling water over the mealiemeal and allow to stand until the meal has swollen out. Add the sugar, salt, eggs and milk when the mixture is quite cold. Stir in the unsifted meal mixed with the baking powder. Bake on a hot girdle until well-browned. It is necessary to bake these girdle cakes a little longer than ordinary girdle cakes.

MUFFINS.

1 cup of mealiemeal
1 cup of meal
½ teaspoon of salt
4 teaspoons of baking powder
1 cup of milk
1 egg
2 tablespoons of butter or fat

Sift and mix together the mealiemeal, meal, salt and baking powder. Gradually add the milk, then the well-beaten egg and melted shortening. Bake in greased muffin pans in a hot oven for 25 minutes.

GREEN-MEALIE LOAF.

5 large mealies
1 teaspoon of sugar
¼ teaspoon of salt

Remove the mealies from the cob and put them through a mincing machine. Add sugar and salt; place in a greased mould or tin and steam for 2 hours. Cut in slices and spread with butter.

SOUR-MILK MEALIEMEAL LOAF.

N.B.—Mealies may be used for bread-making by adding baking powder or soda and sour milk, or mixing the mealiemeal with equal quantities of wheat and rye meal.

1 cup of sour milk
1 teaspoon of bicarbonate of soda dissolved in 1 teaspoon of water
1 egg
1 teaspoon of salt
1½ cups of mealiemeal

Add the soda to the sour milk, beat the yolk of the egg well and add to the milk. Mix the mealiemeal with the salt and add to the mixture. Fold in the stiffly-beaten white of the egg. Bake in a greased pan for 20 minutes at 400° F.

CORNFLOUR TART CRUST.

¾ cup of cornflour
1¼ cups of meal
1 tablespoon of sugar
1½ teaspoons of salt
1 teaspoon of baking powder
6 tablespoons of butter or fat
Yolk of 1 egg
Cold water

Mix and sift the dry ingredients, rub in the shortening with the tips of the fingers, add the well-beaten yolk of the egg. Add water until the dough is adhesive; cool and roll it out.

GOLDEN MEALIEMEAL CAKE.

1 cup of mealiemeal
1 cup of meal
¼ cup of sugar
5 teaspoons of baking powder
¾ teaspoon of salt
1 cup of milk
1 egg
2 tablespoons of shortening

Mix and sift the dry ingredients, and add the milk, well-beaten egg and shortening. Bake in shallow greased tins in a hot oven for 20 minutes.

CORNFLOUR CAKE.

½ pound of butter or fat
½ pound of sugar (castor sugar if possible)
4 eggs
½ pound of cornflour
1 heaped tablespoon soymeal or standard meal
1½ teaspoons of baking powder
1 tablespoon of brandy or milk
1 teaspoon of vanilla or almond essence
Grated rind of 1 lemon or orange

Cream the butter and add the sugar. Mix and sift the dry ingredients and add to the first mixture alternately with milk. Add the flavouring. Pour into greased cake, bread or layer tins and bake at 350° F. for 30 to 60 minutes.

SHORTBREAD.

½ pound of meal
¼ pound of cornflour (or rice or potato meal)
¼ pound of butter
¼ pound of castor sugar (or crushed sugar)
Yolk of 1 egg
2 tablespoons of cream (or rich milk)

Sift the meal, rub in the butter and add the sugar. Mix to a stiff dough with the beaten egg and cream. Roll out and prick with a fork. Bake in a slow oven on a sheet lined with waxed paper. If desired, the dough may be pressed with a spatula into special moulds which have been well sprinkled with maize flour. Remove from the moulds and bake as indicated.

PICKLED MEALIES.

18 mealies
1 small cabbage
1 cup of chopped celery
4 onions
3 large sweet green peppers
4 cups of vinegar
2 cups of brown sugar
½ cup of salt
3 tablespoons of mustard

Immerse the mealies in boiling water for 2 minutes, and remove from the cob. Chop up the cabbage, celery, onion and green peppers (with the pips removed). Mix all the ingredients and boil until soft (25-30 minutes). Seal in clean, hot jars.

MEALIEMEAL SOAP.

7 pounds of fat
1 pound of soda
2 bottles of water
6 pounds of cooked mealiemeal porridg (thin)
½ cup of turpentine

Melt the fat before use. A whiter soap may be obtained if the fat is first strained through fine charcoal or clay. Place the charcoal in a sieve and pour over the fat. Add the soda to the cold water and allow it to cool to the temperature of the fat. Add the fat to the soda and water, stirring all the time. Add the turpentine (or the same quantity of paraffin). Stir until the mixture has the consistency of honey or thick cream. Add the cooked mealiemeal porridge and stir well. Pour into wet moulds or a wooden box lined with a wet cloth. Allow to stand for one hour, and then cut into pieces. Cover well with bags or blankets for three days. Remove from the moulds and store the soap for a week in a warm spot.

From the above it will be seen that the prosaic mealie can play a very important rôle in our daily life.

Foods and Cookery.

The sixth enlarged and revised edition of the Bulletin "Foods and Cookery" has been published recently. It is obtainable from the Government Printer, Pretoria, at 5s. per copy (post free).

Crops and Markets

A Statistical and Economic Review of South African Agriculture

by

The Division of Economics and Markets

Volume 27 February 1948 No. 306

CONTENTS

Crops and Markets.

As from the April 1948 issue, *Crops and Markets* will no longer appear as a supplement to *Farming in South Africa* but as a separate publication in cyclostyled form. Interested persons who are anxious to receive the publication are requested to forward their names and addresses immediately to the Chief: Division Economics and Markets, Union Buildings, Pretoria.

The Cape Onion Crop for the 1948 Season.

As a result of larger plantings and favourable climatic conditions a much larger onion crop will be marketed this year than last year. According to estimates the crop is about 25-30 per cent. larger than that of the previous season. The percentage increase, according to estimates, in the different areas is as follows compared with the 1947 crop:—

Worcester	10	more.
Villiersdorp	25	,,
Vyeboom	25	,,
Elgin	25	,,
Bot River	25	,,
Caledon	25	,,
Diepgat	25	,,
Riviersonderend—Stormsvlei	30	,,
Greyton—Middelplaas	50	,,

A fairly large increase in the plantings occurred particularly in the Greyton-Middelplaas areas.

The World Grain Position.

THE world grain situation is as acute as ever. Reviewing the position of the two most important grains, wheat and maize in the most important exporting countries, the following is evident:—

U.S.A.—The U.S.A., the largest exporter of wheat, had a bumper crop during the past season of approximately 1,365 million bushel (final estimate), as against a crop of 1,156 million in 1946, 1,108 million in 1945 and 1,072 million in 1944. This would have meant that the U.S.A. would have had a considerable surplus available for export.

This hope was, however, frustrated when it became known that the U.S.A. would have a relatively poor 1947 maize crop of 2,447 million bushels as against 3,288 million bushels in 1946.

This drop in the maize crop meant that the country would need a much greater quantity of wheat for domestic feeding purposes. Recently however, the price of wheat has risen sharply in the U.S.A. which will no doubt influence farmers to feed as little as possible and thereby increase marketings. The American Government has also organized a campaign for the conservation of wheat in order that more will be available for export. An export target of 500 million bushels is aimed at.

Canada.—The Canadian wheat crop for 1947 is estimated at about 341 million bushels as against 420 million in 1946 and 318·5 million in 1945.

Canada concluded a four-year wheat agreement with the United Kingdom whereby Canada sells wheat to the U.K. at 155 cents per bushel which is much below the open market price. For the 1948-49 season, however, the contract price has been increased to 2 dollars. Under this agreement Canada has to deliver 160 million bushels. Canadian domestic requirements are estimated to be also about 160 million bushels which leaves a balance of about 108 million bushels for carry-over and export to countries other than the United Kingdom. The corresponding figure for the previous season was 171 million bushels.

Australia.—A record crop of wheat is being harvested in Australia which will assist somewhat in alleviating the position. A preliminary estimate places the crop between 220 and 230 million bushels as against the previous record crop of 213 million bushels in 1930 and the previous season's poor crop of 116·9 million bushels. It is estimated that Australia will have an exportable surplus of about 140 to 150 million bushels of which 75 million bushels have been promised to the United Kingdom and Empire countries.

The Argentine.—The wheat crop for 1947-48 is provisionally estimated at about 23 million quarters as against 27·6 million the previous season. The 1946-47 maize crop approximated about 27 million quarters of 480 lb. as against 16·4 million in 1945-46 and 13·6 million in 1944-45.

Prices of Grains in U.S.A. and Canada.

In the following table average monthly prices of wheat, maize and oats realized on the Chicago grain exchange (U.S.A.), and of wheat, rye, oats and barley on the Winnipeg grain exchange (Canada), are given for the period January 1946 to December, 1947. These monthly averages have been computed from daily price quotations.

Prices of wheat, maize, rye, oats and barley on the Chicago (U.S.A.) and Winnipeg (Canada) Grain Exchanges.

	CHICAGO.			WINNIPEG.			
	Wheat 2 Red Winter Cash Cents per 60-lb.	Maize No. 2 Yellow Cash Cents per 56-lb.	Oats Cash Cents per 32-lb.	Winnipeg Wheat No. 1 North Manitoba Class 2 in Store Fort William Cents per 60-lb.	Rye Cents per 56-lb.	Oats Cents per 34-lb.	Barley Cents per 48-lb.
1946:							
January .	180·5	118·5	—	—	208·4	—	—
February .	180·5	118·5	—	—	249·5	—	—
March. .	183·5	121·5	—	—	241·3	—	—
April.. ...	183·5	121·5	—	—	261·1	—	—
May	192·3	130·3	—	—	272·5	—	—
June	198·5	146·5	—	—	282·7	—	—
July.......	208·7	218·1	91·8	—	295·7	—	—
August....	200·5	188·3	79·4	—	200·6	—	—
September.	207 0	201·0	85·5	—	227·5	—	—
October...	211·3	179·5	89·5	—	231·5	—	—
November.	208·9	142·3	87·5	—	251·8	—	—
December..	212 7	136·6	87·0	229 3	265·7	—	—
1947:							
January. .	224·0	135·5	85·0	228·0	256·0	—	—
February..	231·9	141·9	88·2	244·8	283·6	—	—
March.. .	278·0	174·8	98·2	290·0	314·4	—	—
April......	259·8	184·1	95·4	284·0	293·2	—	—
May......	267·5	180·6	101·5	289·0	351·6	—	—
June......	240·7	210·4	105·8	260·3	345·6	—	—
July..... .	230·8	218·3	107·4	251·8	362·6	—	—
August ...	242·4	243·5	108·9	261·0	293·0	—	—
September.	270·0	255·9	120·1	292·5	374·5	70·0	120·0
October....	300·4	246·1	122·9	321·4	390·9	90·1	120·8
November.	303·5	247·9	123·8	327·8	389·3	86·1	123·1
December..	307·0	259·8	129·3	334·0	398·5	86·0	127·4

ne U.S.A. ceiling prices for all grains were removed as from 1 July 1946 but up to October, 1946, the open market was largely determined by the Commodity Credit Corporation which used to be the sole export agency. As from October 1946, however, the C.C.C. no longer bought wheat and other foods on behalf of foreign governments. From this date onwards Governments or private importers had to compete on the American open market for their requirements.

In the case of Canada, the Winnipeg " futures " market has been closed since September 1943, for wheat, oats, and barley. In October 1947 futures trading in oats and barley have again been resumed.

From the above table it is evident that from July 1946, when *price ceilings* on grains in the U.S.A. were removed the price of wheat on the Chicago Exchange advanced very rapidly from about 2 dollars per bushel to over 3 dollars towards the end of 1947. Maize prices have also risen very sharply.

Prices of " free " wheat on the Winnipeg Exchange have also increased markedly during 1947. Prices for rye, oats and barley show similar advances. The failure of the European crops due to a particularly severe winter and an exceptionally dry summer, together with the short maize crop of the U.S.A., have all contributed towards the considerable rise in prices of all grains.

Prospects for 1948: Grain Crops.

Argentine maize crop.—Reports indicate that the new crop is developing well following good rains. No official estimate of the area planted is as yet available but from further reports it would appear that the acreage has been seriously reduced because of the price the grower receives for his crop. The price at which the Government takes in maize as well as all other grains from growers under a five-year-plan is much below the open market price and leaves a small margin of profit to the producers.

European winter cereals.—Newly sown crops of winter grain in Europe have made fair progress due to plenty of rain and mild temperatures according to reports received up to the end of December, 1947.

U.S.A. winter wheat crop.—Prospects for the newly sown winter wheat crop have improved although it would appear that a smaller acreage has been seeded according to reports received up to the end of December.

Fruit Crop Estimate: End of December 1947.

(Western Province Fruit Research Station).

EXTREMELY hot weather was again experienced during December and the precipitation was only 0·18 inch, which is considerably below the average. The drought conditions have also been aggravated by strong south-easterly winds.

The apricot crop is estimated at 15,000 tons which is much bigger than the earlier estimate. Good peach and plum crops have been harvested. Only moderate crops of pears and apples are expected. Up to the beginning of the month, the prospects for a good grape crop were very promising, but the prolonged drought and warm days had already caused signs of lack of moisture and sun-scorch.

As a result of the use of D.D.T. in the spraying programme the codling-moth position is very favourable. On some farms fruit-fly infestation as well as fruit mildew, is very severe.

Agricultural Conditions in the Union during December 1947.

Weather Conditions.—Good showers occurred throughout the Union during the month. As a result of the rain the drought in the northern and western Transvaal was broken and farmers were in the position to plant their crops. Other parts, where the drought conditions were also severe have had good showers.

Crops.—Farmers were busy ploughing and planting for summer cereals. Young crops are very promising. Although fruit-flies caused considerable damage to fruit a good fruit crop has been harvested in the western Cape Province. The prospects for young crops in Natal, e.g. sugar-cane, maize, kaffircorn, and peanuts, are very promising and good crops are expected should climatic conditions remain favourable. Excellent wheat crops have been harvested in the northern Orange Free State but rain hampered the harvesting of good wheat crops in the eastern Orange Free State.

Stock and Pastures.—The condition of stock and pastures improved satisfactorily as a result of the rain which occurred. Except for lumpy skin disease in the western and south-western Cape Province, the Karoo, the Transkei and Natal, as well as nagana in Natal, stock diseases were quiet. In the Karoo blowflies caused considerable trouble among sheep.

Index of Prices of Field Crops and Pastoral Products.

This index, as shown elsewhere in this issue, remained unchanged for December 1947, viz. at 225. The most important changes occurred in the following groups:—

(*a*) "Hay" decreased from 169 to 148 owing to a decrease in the price of lucerne.

(*b*) "Other Field Crops", i.e. potatoes, sweet potatoes, onions and dry beans, increased from 266 to 268 as a result of an increase in the price of potatoes and sweet potatoes.

(*c*) "Pastoral Products" decreased from 242 to 240 due to a small decrease in the price of wool.

(*d*) "Poultry and Poultry Products" increased from 184 to 210 owing to a further increase in the price of eggs.

Average Prices of Potatoes (per 150 lb.) on Municipal Markets.

Season 1 July to 30 June.	Johannesburg. Transvaal N.M. all classes. Grade I.	Johannesburg. Transvaal. Ordinary No. I.	Johannesburg. Transvaal. Ordinary No. II.	Durban. Natal Ordinary No. I.	Durban. O.F.S. Ordinary No. I.	Pretoria. Transvaal N.M. classes. Grade I.	Cape Town. Cape Ordinary No. I.	Cape Town. Transvaal Ordinary No. I.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1938–39....	8 5	6 9	6 2	8 10	8 4	8 5	8 2	8 6
1939–40....	8 4	6 7	6 7	9 10	8 9	8 3	9 0	10 2
1940–41....	18 4	14 2	13 4	16 10	17 1	15 10	15 7	17 0
1941–42....	24 8	19 3	18 7	23 3	21 0	25 1	20 1	22 7
1942–43....	16 4	13 7	12 6	16 9	17 8	16 6	15 0	17 8
1943–44....	28 10	17 1	15 0	23 6	19 4	20 5	21 2	22 10
1944–45....	25 6	25 1	19 2	25 5	24 4	25 4	25 4	28 1
(*a*)	Grade I.	Grade II.	Grade III.	Grade I, all classes.	Grade I, all classes.	Grade I.	Grade I, all classes.	Grade I, all classes.
1945–46....	30 11	24 11	15 9	28 9	29 8	29 6	30 11	30 7
1946-47..	20 5	16 3	13 0	18 8	24 3	19 6	23 1	15 11
1946—								
January..	34 8	30 9	19 5	34 1	—	35 8	31 6	—
February.	25 7	19 5	11 3	28 2	30 6	24 2	35 6	33 3
March.....	23 9	18 3	11 7	26 3	25 11	24 0	29 8	29 5
April.....	27 0	22 2	13 8	28 4	36 8	27 3	31 1	32 6
May.......	27 3	21 5	13 1	28 2	29 1	25 2	27 1	27 11
June.....	28 0	23 3	15 8	25 8	25 9	29 0	30 8	30 4
July......	28 8	23 11	16 2	31 11	32 0	31 3	31 5	32 10
August...	31 9	26 1	16 0	33 6	32 5	33 2	33 2	34 6
September	35 8	28 0	17 7	35 9	36 6	35 6	33 11	34 6
October...	36 3	29 2	20 11	36 10	37 2	33 11	34 6	—
November	26 10	23 5	16 0	33 9	33 10	24 8	28 11	—
December	18 11	16 0	12 1	26 6	29 9	19 6	19 4	—
1947—								
January..	12 4	9 0	6 5	15 1	—	11 8	15 6	15 1
February.	10 1	7 9	5 9	12 7	12 11	9 9	15 5	14 9
March....	9 6	7 2	5 10	14 0	9 10	9 7	12 9	13 5
April.....	11 5	8 2	6 3	12 10	11 7	11 10	15 3	13 11
May......	12 8	9 10	7 4	17 8	17 6	12 8	18 0	14 7
June.....	17 4	13 4	9 5	18 7	16 11	17 5	21 11	17 8
July......	16 11	12 5	7 11	20 1	19 4	16 1	22 11	18 0
August...	16 2	10 5	6 5	16 7	16 3	15 2	21 6	20 10
September	17 6	10 8	6 7	16 0	13 3	18 5	28 8	18 11
October..	22 3	15 8	9 8	21 8	16 9	22 1	27 10	21 0
November	25 0	19 1	12 7	28 9	27 2	14 2	28 5	23 1
December	26 4	22 0	14 4	32 0	—	23 9	24 4	29 11

(*a*) As from July 1945 compulsory grading was introduced on the nine controlled markets of the Union and the National Mark grades were abolished.

Index of Prices of Field Crops and Animal Products.

(Basic period 1936-37 to 1938-39=100.)

SEASON (1 July to 30 June).	Summer cereals. (a)	Winter cereals. (b)	Hay. (c)	Other field crops. (d)	Pastoral products. (e)	Dairy products. (f)	Slaughter stock. (g)	Poultry and poultry products. (h)	Combined index.
WEIGHTS.	19	13	2	3	34	6	17	6	100
1938-39.......	92	109	96	89	79	102	106	94	93
1939-40.......	86	114	77	95	115	105	106	89	104
1940-41.......	108	120	106	156	102	108	110	103	109
1941-42.......	120	144	143	203	102	131	135	136	124
1942-43.......	160	157	144	159	122	147	168	167	147
1943-44.......	170	186	137	212	122	154	185	188	159
1944-45.......	183	186	160	281	122	177	179	184	164
1945-46.......	201	194	164	312	118	198	185	170	170
1946-47.........	241	209	149	232	169	205	192	204	198
1946—									
July...........	245	194	182	303	120	231	183	193	182
August........	242	194	181	319	120	231	188	164	181
September.....	243	194	183	351	163	231	196	156	198
October........	240	194	166	365	171	231	204	155	201
November.....	240	210	165	309	179	194	208	171	204
December......	242	210	157	236	168	194	208	201	200
1947—									
January.......	242	210	144	174	178	194	200	238	202
February......	240	210	127	157	187	194	191	248	203
March..........	240	210	154	158	189	194	182	251	203
April..........	239	210	176	169	190	194	179	283	205
May............	225	210	166	187	192	194	183	318	206
June..........	225	210	169	213	174	247	186	291	203
July.........	224	210	184	216	175	261	191	207	200
August.. . . .	225	210	184	213	176	261	196	188	200
September.....	226	210	184	229	228	261	200	169	218
October........	227	210	151	265	221	261	210	176	218
November. . .	226	212	169	266	242	211	216	184	225
December... ..	226	212	118	268	210	211	217	210	225

(a) Maize and kaffircorn.
(b) Wheat, oats and rye.
(c) Lucerne and teff hay.
(d) Potatoes, sweet potatoes, onions and dried beans.
(e) Wool, mohair, hides and skins.
(f) Butterfat, cheese milk and condensing milk.
(g) Cattle, sheep and pigs.
(h) Fowls, turkeys and eggs.

Prices of Bananas and Pineapples on Municipal Markets.

SEASON.	BANANAS (Per Crate) (a)			PINEAPPLES. (b)						
	Cape Town.	Johannesburg.	Pretoria.	Cape Town. Box.	Durban. Doz.	Johannesburg. Ordinary. Doz.	Johannesburg. Queens and Giants. Doz.	Port Elizabeth. Box.	East London. Doz. Large.	Bloemfontein. Bushel Box.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1938-39........	22 5	9 10	16 5	5 4	3 3	1 1	—	3 5	1 2	4 10
1939-40.........	24 4	8 7	15 10	6 1	3 10	1 4	4 8	3 10	1 5	4 9
1940-41.........	27 0	7 2	14 3	5 10	2 8	1 5	2 1	4 5	1 5	5 10
1941-42.........	28 6	7 6	14 6	6 6	3 0	1 7	2 5	4 6	1 8	6 2
1942-43........	30 0	11 9	22 7	7 4	3 0	1 8	3 10	4 11	2 1	7 3
1943-44.........	37 8	13 2	18 10	8 3	3 6	2 4	2 1	6 3	2 10	8 4
1944-45.........	38 10	13 0	15 3	10 4	3 9	2 6	3 9	7 3	3 3	8 6
1945-46.........	67 0	20 1	28 7	10 4	4 7	4 1	4 8	8 11	3 11	10 7
1946—										
July...........	60 11	25 4	25 8	15 7	3 2	9 3	10 3	15 5	5 7	13 5
August.........	72 1	23 9	31 5	19 10	4 10	7 11	9 7	16 10	4 7	13 10
September.....	66 5	20 6	30 8	10 1	7 7	6 5	7 2	12 2	4 7	13 11
October........	78 10	28 6	34 6	15 5	6 5	6 9	6 5	13 10	4 3	14 5
November......	63 8	47 10	32 4	14 10	8 11	6 3	5 4	13 10	4 6	15 11
December......	67 7	30 7	35 4	16 5	4 5	7 0	—	11 11	4 7	17 8
1947—										
January.......	41 7	20 2	20 4	9 2	5 1	2 3	3 6	6 8	3 6	7 5
February......	46 0	14 10	15 10	6 10	2 0	2 0	2 7	5 4	3 7	6 8
March.........	47 5	18 4	22 10	9 3	—	3 6	—	8 3	5 2	11 8
April..........	57 2	24 8	23 8	12 9	—	4 5	—	9 5	4 1	13 10
May...........	62 0	20 1	26 8	7 11	—	4 3	—	8 2	4 4	9 6
June..........	32 7	19 6	23 11	9 3	—	3 8	—	6 11	2 11	9 6
July.	55 1	17 6	23 4	7 3	—	4 3	—	7 5	3 7	8 7
August........	44 6	20 4	16 9	8 5	7 2	5 2	—	9 9	3 1	9 11
September.....	55 8	21 10	21 7	9 10	—	4 5	—	8 0	3 7	8 4
October........	57 7	20 2	25 7	10 10	8 3	5 0	—	11 5	3 8	10 9
November.....	60 5	18 2	20 8	12 7	11 2	8 2	—	17 10	5 6	12 6
December......	53 2	15 9	17 3	14 10	2 6	8 7	—	18 5	5 8	12 1

(a) Season 1 January to 31 December.
(b) Season 1 October to 30 September.

Average Prices of Onions and Sweet Potatoes on Municipal Markets.

Season (1 July to 30 June).	Onions (120 lb.). Johannesburg. Transvaal.	Onions. Johannesburg. Cape.	Onions. Cape Town. Cape.	Onions. Pretoria. Cape.	Onions. Durban. Local.	Onions. Durban. Cape.	Sweet Potatoes (120 lb.). Johannesburg. Table.	Sweet Potatoes. Durban.	Sweet Potatoes. Cape Town.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1938-39	8 3	8 10	7 4	7 10	8 6	9 6	5 7	4 8	5 3
1939-40	6 3	9 10	7 3	9 11	9 8	10 5	5 7	5 9	5 0
1940-41	12 5	12 3	9 10	11 11	11 2	12 7	7 3	6 4	5 5
1941-42	10 5	13 11	10 4	13 10	13 0	14 3	9 10	7 1	8 4
1942-43	13 8	14 0	12 6	14 7	12 9	14 5	9 8	8 1	8 5
1943-44	16 2	18 9	15 1	17 4	19 1	19 2	12 0	10 9	10 7
1944-45	14 3	18 5	15 0	18 1	18 8	19 5	17 3	15 1	16 3
1945-46	12 4	14 11	12 9	15 3	14 9	15 7	14 11	13 5	14 7
1946-47	21 0	19 0	17 4	19 3	23 2	20 0	16 3	14 6	16 11
1946—									
July	11 10	14 3	12 0	15 0	15 2	15 6	15 2	15 2	17 4
August	14 9	17 0	13 7	15 10	20 6	18 7	16 10	16 0	18 3
September	20 9	25 3	20 4	23 2	21 5	23 3	20 0	16 5	22 11
October	24 9	28 1	32 5	24 0	32 3	31 8	24 6	16 9	20 10
November	21 11	—	26 11	—	24 8	21 1	23 10	15 1	20 8
December	16 8	15 2	12 4	—	19 8	19 6	18 11	11 11	25 5
1947—									
January	14 9	14 0	11 5	14 10	15 6	14 3	16 6	9 6	19 8
February	14 8	14 5	11 9	13 7	16 1	17 8	16 11	7 6	18 11
March	17 6	18 7	14 3	20 3	13 4	17 6	15 6	13 4	16 1
April	20 7	22 2	17 10	22 3	24 11	24 4	12 7	8 4	10 9
May	22 4	24 11	20 11	26 2	27 5	24 1	10 1	8 6	11 7
June	26 2	26 9	23 3	26 9	26 4	27 2	9 9	7 5	11 5
July	31 5	31 5	25 2	30 6	29 10	34 5	8 6	7 10	10 9
August	22 5	42 8	40 2	43 9	37 8	4[illegible] 11	8 2	6 5	8 1
September	43 1	50 10	45 10	46 2	50 11	52 0	8 1	5 11	11 7
October	27 0	45 3	41 5	—	31 9	71 3	9 5	7 5	10 7
November	12 2	13 4	15 6	-	17 5	13 0	11 3	7 7	12 0
December	10 11	11 7	8 8	—	15 5	14 7	10 7	8 4	12 11

Prices of Avocados and Papaws on Municipal Markets.

Season.	Avocados (Per Tray). (a) Cape Town.	Avocados. Durban.	Avocados. Johannesburg. Ordinary.	Avocados. Johannesburg. N.M.	Papaws. (b) Cape Town Std. Box.	Papaws. Durban. Tray.	Papaws. Johannesburg. Ordinary Std. Box.	Papaws. Johannesburg. N.M. Std. Box.	Papaws. Port Elizabeth Std. Box.	Papaws. Bloemfontein Std. Box.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1938-39	1 6	0 11	1 3	1 11	2 0	0 10	1 7	2 0	2 0	1 8
1939-40	2 1	1 2	1 9	2 11	2 3	0 10	1 4	1 9	1 11	1 6
1940-41	1 10	0 10	1 5	2 4	2 1	1 1	1 9	2 2	2 3	1 9
1941-42	2 4	1 7	2 1	3 4	2 5	0 10	1 10	2 1	1 11	2 0
1942-43	3 1	1 8	2 10	4 3	3 2	1 2	2 1	2 7	2 2	2 0
1943-44	4 1	1 6	3 7	5 2	3 2	1 5	2 5	3 5	3 3	2 7
1944-45	2 8	1 8	3 0	5 10	3 4	1 6	3 1	4 1	3 5	3 0
1945-46	3 8	2 5	3 11	5 10	3 6	1 6	3 6	4 5	3 7	3 3
1946-47	—	—	—	—	3 2	1 6	3 2	4 8	3 3	2 9
1946—										
July	4 1	1 9	5 6	6 3	4 11	2 7	5 4	6 0	6 3	4 11
August	5 7	5 1	5 10	6 8	5 1	2 6	4 4	5 1	4 9	4 4
September	9 3	—	6 5	5 8	2 10	1 6	2 8	3 2	2 3	2 11
October	8 8	4 7	5 11	6 7	2 5	1 4	1 9	2 4	2 2	1 10
November	8 6	3 6	6 3	7 4	2 8	0 8	2 3	2 11	2 11	2 8
December	8 9	2 0	5 11	8 3	3 7	1 9	3 7	4 8	4 11	2 6
1947—										
January	7 11	—	5 5	—	4 6	1 8	4 10	6 6	8 0	3 9
February	2 6	—	2 11	—	4 9	1 5	7 10	—	8 11	—
March	2 0	2 1	2 11	3 11	6 5	3 10	8 2	8 1	—	3 5
April	2 7	1 2	2 7	3 6	6 4	1 6	6 0	6 9	7 2	4 7
May	2 2	1 2	3 6	4 9	3 7	2 0	3 10	5 2	4 1	3 3
June	2 8	1 4	3 9	4 5	3 2	1 8	3 10	4 5	3 9	3 3
July	3 8	1 5	4 5	5 11	3 6	1 11	3 2	4 0	3 0	3 2
August	5 0	2 2	5 2	5 11	2 11	1 3	2 7	3 1	2 9	3 0
September	5 6	3 6	4 11	5 5	2 0	1 0	2 4	2 8	2 0	2 5
October	6 0	—	5 1	5 11	2 6	1 0	2 3	3 1	3 2	2 9
November	5 9	—	5 4	7 8	3 1	1 3	2 5	3 1	3 1	2 7
December	14 3	—	5 8	4 9	3 1	1 5	1 9	2 6	2 7	2 3

(a) Season 1 January to 31 December.
(b) Season 1 April to 31 March.

Average Prices of Green Beans, Green Peas and Carrots on Municipal

Season (1 July to 30 June.)	Green Beans (Pocket 20 lb.).			Green Peas (Pocket 20 lb.).			Carrots (Bag). (a)		
	Johannesburg.	Cape Town.	Durban.	Johannesburg.	Cape Town.	Durban.	Johannesburg.	Cape Town.	Durban
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1938-39.......	1 8	2 3	2 0	2 4	1 9	1 2	3 8	2 6	6 1
1940-41.......	1 11	2 9	1 5	2 8	2 4	2 3	5 9	4 11	13 4
1941-42.......	2 7	3 10	2 6	3 11	3 3	3 4	8 5	8 11	17 2
1942-43.......	3 1	4 3	3 0	3 3	2 10	3 9	5 1	8 9	18 2
1943-44.......	3 8	4 11	3 0	4 11	4 10	4 11	9 11	11 1	20 2
1944-45.......	3 7	5 1	4 1	4 9	4 1	5 5	8 3	9 11	19 10
1945-46.......	3 4	4 7	3 6	5 11	7 2	6 1	8 10	11 4	17 1
1946-47.......	3 11	3 7	3 6	4 10	4 3	5 0	5 9	4 9	14 11
1946—									
July..........	3 2	1 11	2 2	2 7	3 6	3 4	3 8	4 8	7 10
August.........	6 3	4 2	6 6	5 10	5 0	4 9	4 5	3 8	11 0
September.....	6 6	7 5	6 4	5 0	4 11	5 1	3 8	3 2	10 11
October........	5 0	5 0	5 2	3 3	3 6	5 7	4 7	4 1	9 7
November.....	2 11	2 7	1 11	6 5	3 10	9 5	6 3	3 7	11 5
December......	3 9	2 8	2 5	9 0	—	7 0	7 6	5 4	19 5
1947—									
January.......	3 0	—	3 5	4 0	8 7	4 9	7 7	—	16 5
February......	4 2	—	5 1	3 2	—	5 8	10 4	—	12 8
March.........	3 5	—	2 8	5 3	—	7 5	16 8	20 0	24 5
April..........	2 7	2 5	2 1	6 7	5 1	7 8	13 4	4 11	27 1
May...	3 0	3 3	2 5	9 0	4 0	4 8	8 10	18 8	23 8
June..........	2 11	3 4	4 3	5 9	4 4	3 7	7 1	17 11	16 7
July..........	6 0	4 6	5 2	5 8	5 5	4 11	6 0	11 7	15 11
August.........	10 2	9 1	8 0	5 0	3 8	3 4	9 3	7 7	13 7
September.....	3 9	5 4	2 8	3 6	3 0	2 10	6 4	7 0	9 0
October.....	2 9	2 6	1 9	4 11	2 11	3 9	7 7	7 7	11 5
November.....	3 0	1 9	4 6	6 5	4 8	5 0	9 9	5 10	11 6
December......	2 7	3 4	5 1	7 3	7 5	9 6	5 8	7 9	11 8

(a) Weights of bags vary, but on the average are approximately as follows:—Johannesburg, 130 lb. Town, 90 lb.; and Durban, 120 lb.

Average Prices of Cabbages, Cauliflower and Tomatoes on Municipal Markets.

Season (1 July to 30 June).	Cabbages (Bag). (a)			Cauliflower (Bag). (a)			Tomatoes (Trays 15 lb.).			
							Johannesburg.			
	Johannesburg.	Cape Town.	Durban.	Johannesburg.	Cape Town.	Durban.	N.M. No. 1.	Other.	Cape Town.	Durban.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1938-39.......	3 10	3 0	3 10	3 0	1 8	3 5	2 2	1 3	1 8	0 10
1940-41.......	5 10	4 8	7 1	3 11	4 3	5 3	2 7	1 6	2 1	1 2
1941-42.......	8 10	5 5	11 5	5 9	5 7	7 11	3 1	1 9	2 3	1 6
1942-43.......	5 6	5 11	9 1	5 0	5 9	7 6	3 4	1 10	2 1	2 7
1943-44.......	11 1	7 4	17 6	9 2	6 2	12 1	5 5	2 9	3 7	2 0
1944-45.......	9 7	6 11	13 5	7 5	6 6	9 8	4 1	2 0	2 10	1 9
1945-46.......	10 1	7 1	10 11	8 4	6 5	11 1	4 11	2 4	3 4	1 7
1946-47.......	6 7	6 4	10 6	8 4	11 2	10 5	4 3	2 5	2 8	2 5
1946—										
July..........	7 11	1 10	9 9	8 6	—	11 3	2 2	1 1	2 3	1 0
August.........	5 9	2 1	7 1	8 9	3 2	11 1	2 5	1 3	1 11	0 9
September.....	4 11	2 5	5 8	9 6	4 0	13 7	3 2	1 9	2 2	1 1
October........	5 6	8 0	7 0	15 10	13 7	12 0	4 5	1 9	2 8	0 11
November......	5 7	11 5	12 0	13 4	15 1	—	5 2	2 1	3 4	1 1
December......	8 9	9 11	11 11	11 10	—	—	4 8	1 11	3 0	1 10
1947—										
January.......	9 0	12 3	5 9	11 3	23 8	—	5 0	2 0	2 11	1 6
February......	11 4	14 10	14 3	12 5	15 2	—	5 6	2 3	3 4	3 1
March.........	12 0	17 2	17 6	12 1	16 6	31 5	7 10	3 9	4 0	2 9
April..........	7 1	14 9	16 0	6 2	14 2	11 9	6 2	2 9	3 8	2 3
May...........	6 8	10 4	12 1	7 0	9 9	9 5	7 4	3 8	2 10	2 5
June..........	6 1	8 3	8 6	8 5	8 8	9 0	5 2	2 5	4 4	1 11
July..........	6 0	6 9	7 0	7 4	7 6	9 10	3 8	1 8	2 3	1 9
August.........	4 1	7 3	5 5	5 1	10 3	5 5	3 10	1 11	2 9	1 3
September.....	4 5	7 0	4 4	9 1	10 0	5 9	7 2	3 9	4 1	1 3
October.......	5 5	7 0	4 7	16 9	16 2	—	5 0	1 10	2 8	1 2
November.....	4 8	5 2	6 4	6 11	11 3	—	4 11	1 11	3 5	1 1
December......	4 11	6 0	8 0	10 8	11 0	—	5 2	1 11	4 4	1 9

(a) Weights of bags vary, but on the average are approximately as follows: For cabbage.—Johannesburg, 150 lb.; Cape Town, 105 lb.; and Durban, 90 lb. For cauliflower—Johannesburg, 100 lb., Cape Town, 65 lb. and Durban, 85 lb.

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[*Photo on Cover* · Water Catchment Area, Drakensberg.]

[NOTE.—Articles from *Farming in South Africa* may be published provided acknowledgment of source is given.]

G.P.-S.10655—1947-8—8,500.

The Retirement of Dr. P. J. Du Toit.

ON 16th March Dr. P. J. du Toit, retired from his position as Director of Veterinary Services, after having occupied it with great distinction for 21 years.

Dr. du Toit was born at Somerset Strand in 1888, and after a brilliant school and university career he was awarded the Queen Victoria Scholarship in 1908 and proceeded overseas to study in Germany and Switzerland. He devoted his time to the study of zoology, obtaining an honours degree in 1912 at Zurich. This subject was his first love in science and has continued to remain so throughout his career, and which he continued in the study of protozoological and virus-diseases. During a visit to South Africa in 1912 he decided to take up veterinary science, and then proceeded overseas to continue his studies at the Veterinary High School in Berlin, where, after qualifying, he commenced his career of research under Professor Knuth with whom he collaborated as co-author of a standard text book (in German) on tropical diseases of domestic animals. During this period he wrote a thesis on "Leukaemia in Cattle" for which he was awarded the Doctorate in Veterinary Medicine in 1916.

On his return to South Africa in 1919, he was fortunate in immediately gaining an insight into one of South Africa's most devastating cattle diseases, lamsiekte. He was appointed a senior veterinary research officer and joined Sir Arnold Theiler in his work on this disease at Armoedsvlakte, in Bechuanaland, where the latter had gone after his first retirement in 1918. When Sir Arnold returned to Onderstepoort in 1920 as Director on the resignation of Mr. R. E. Montgomery, Dr. du Toit accompanied him and was appointed a Sub-Director, later in the year becoming Deputy Director. After a period of several years in which he had the opportunity of studying the methods of that great investigator, Sir Arnold Theiler, at close hand, he succeeded him in 1927, being appointed Director of Veterinary Services and Animal Husbandry. Just before taking over the directorship he spent a year overseas in special studies on tropical diseases.

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FARMING IN SOUTH ... AFRICA

VOL. 23 MARCH 1948 No. 264

Editorial:

Insects and Timber.

WOOD is one of the most wonderful substances in the world, and in spite of all our recent discoveries of new plastics and synthetic building materials, it continues to hold its own as one of the most essential ingredients of the modern home.

It is a great pity, therefore, that South Africa has no great indigenous forests and is naturally poor in timber, although, on the other hand, we have a marvellous variety of hardwoods, many of which are most beautiful when worked and polished. It is the shortage of building timber that has very much accentuated the housing shortage in this country.

In other countries where they have great natural forests and a plenty of wood, it would shock the South African to see how timber is being wasted or used for purposes which we should never dream of. Here we must plant our forests by hand, and on this account should carefully preserve every bit of timber to the best of our ability.

In some ways wood is marvellously durable. There are beams in Westminster Abby that have remaind sound for hundreds of years, and even where buildings burn, thick roof timbers will resist the heat and hold up the roof long after iron girders melt and collapse. Along our coast there are still the remains of old wooden ships which were wrecked during the past century while the metal parts of those same ships have long since rusted away.

Unfortunately, however, timber in South Africa is very subject to the attack of wood-boring beetles and termites which will quickly reduce it to powder or hollow it out and, in a short time destroy its strength if it becomes infested.

The damage that is being done by these insects to woodwork in buildings is terrific and is far greater than most people realize. It is not as spectacular as a forest fire or an air-raid, but it goes on continously and insidiously day and night so that in the end the loss is greater than from any other destructive agency.

Of termites, there are a large number of species, each with distinct habits and methods of destroying woodwork in houses. Most of these make their nests in the ground and attack floors and timber in contact with the soil. There is now, however, a species that nests in timber right away from the soil and is destroying roof timbers and woodwork in high buildings in Durban and Port Elizabeth.

There are also many wood-boring beetles, and they too have a great variety of destructive habits. On the whole these attack wood in the upper parts of buildings. The European house borer attacks Pine wood at Port Elizabeth and in the Western Cape Province while the Powder Post beetle attacks the sapwood of hardwoods in all parts of South Africa. In the family Bostrichidae there is a whole series of timber-boring beetles which destroy bamboo, bluegum, kiaat and many other woods, while the Furniture or Death Watch beetle attacks many kinds of old wood in houses, mainly in coastal regions.

  [Contiued on page 150.

The New Chief of Onderstepoort.

DR. GILLES DE KOCK, M.R.C.V.S., Dr. Med. Vet., D.Sc. has been appointed as Director of Veterinary Services, with effect from 16 March 1948, in succession to Dr. P. J. du Toit, upon the latter's retirement on superannuation.

Gilles van de Wall de Kock was born in Pretoria in 1889, and received his education in Pretoria, Stellenbosch and Cape Town.

In 1908 he was awarded a Government bursary and proceeded to the Royal College of Veterinary Surgeons in London to take up the study of Veterinary Science. After a very successful University career, he obtained his M.R.C.V.S. in 1913, and then took a post-graduate course in London.

After his return to South Africa he was appointed as Veterinary Research Officer at Onderstepoort in January 1914. In 1919 he resigned this position and proceeded overseas to continue his medical studies.

The following year he was appointed as Professor of Anatomy at the University of Stellenbosch. He filled this post for one year only, as at the end of 1920 he was induced by the late Sir Arnold Theiler to come back to Onderstepoort as Professor of Anatomy and Senior Veterinary Research Officer.

In 1922 he went overseas on a year's study leave, which he spent in Switzerland and Germany. The degree of Dr. Med. Vet. was awarded to him by the Veterinary College of Bern, Switzerland.

In 1927 Dr. de Kock was promoted to the post of Sub-Director of Veterinary Services, and in 1931 to Deputy-Director of Veterinary Services and Animal Industry.

In 1928 Dr. de Kock was awarded the degree of D.Sc. by the University of Witwatersrand.

In 1929-1930 he spent another year overseas, part of which was devoted to the study of pathology under the famous Professor Aschoff at the University of Freiburg in Germany, and part to special studies at the Rockefeller Institute in New York, where he devoted much of his time to the study of tissue culture, being associated with the famous Professor Carrel.

He started his research career at Onderstepoort by studying certain blood diseases in horses, particularly Nuttaliosis and Infectious

Anaemia. This latter disease formed the subject of his excellent thesis which was presented to the University of Bern.

His next research also dealt with blood changes and blood diseases in its relation to the function of the spleen. In conjunction with Dr. Quinlan, he carried out splenectomy experiments and was able, in this way, to detect several parasites in the blood of sheep which had not previously been seen in South Africa. In the course of his subsequent work he also devoted considerable attention to the subject of haematology.

Since his appointment as Professor of Pathology, Dr. de Kock has devoted much time to this aspect of veterinary science and has made valuable contributions. One of the subjects that occupied much of his attention was the study of neoplasms in animals.

Apart from the position he occupies on the Council of the National Cancer Association of South Africa, Dr. de Kock has also devoted much time to the study of diseases caused by poisonous plants, particularly Dunsiekte in horses. This has led him to investigations in regard to the pathology of the liver.

Lately he has concentrated his energies on the study of the vast problem of tuberculosis in cattle.

Dr. de Kock has achieved success not only as a teacher and research worker, but also as an administrator. In the very responsible position which he occupies in the Department of Agriculture, he has rendered enormous services to the country. He has also served his profession as a member on the Council of the South African Veterinary Medical Association. In 1934 the South African Biological Society honoured him by giving him the Senior Captain Scott Medal. Furthermore, he has taken a leading part in bringing about a better understanding and closer co-operation between the Medical and Veterinary professions in South Africa.

He is now President of the South African Association for the Advancement of Science and a member of the National Nutrition Council and of the National Medical Council. He is also a member of the Suid-Afrikaanse Akademie vir Kuns en Wetenskap.

Since 1934 he has played an active part in the campaign against the tsetse fly in South Africa and lately has been actively associated with the D.D.T.-spraying operations in Zululand.

In 1936 Dr. de Kock represented the Union Government at the Imperial Scientific Conference, and in 1936-1937 studied at the Tropical Diseases Institute, Hamburg, the State Serum Institute, Copenhagen, and at the Medical Research Institute, Hampstead, London.

In October 1947 Dr. de Kock proceeded to the United States of America for three months to follow trends of research at various Institutes in New York, Washington, Chicago, Toronto, etc. At present he is occupying the Chair of Comparative Pathology at the University of Pretoria.

The Retirement of Dr. P. J. du Toit:—

[*Continued from page 146.*

When the Veterinary Faculty was established at Onderstepoort in 1920 he became Professor of Infectious diseases, and he has retained this Chair until his retirement this year. He has also been Dean of the Faculty since Sir Arnold's retirement.

In 1927 he was an official delegate to the Imperial Agricultural Conference in London in which he played a prominent part, and in

recognition of the importance of Onderstepoort as a research centre it was then decided to give a grant of money to establish several fellowships for special studies at that institution and for the building of a library, the expenses being defrayed by the newly constituted Empire Marketing Board. These fellowships resulted in much valuable research work being done.

In 1929, Dr. du Toit presided at the 6th Pan African Veterinary Conference held in Pretoria.

In 1930 he attended an Empire Wool Conference in Great Britain and in the same year was president of Section M, Agriculture, at the British Associations' Meeting at Bristol. He has been a member of the Wool Council for many years and has always shown a keen interest in the problems of the wool farmer.

In matters concerning the veterinary profession as a whole he has played a big part both in South Africa and the world in general. For some years he was president of the South African Veterinary Medical Association, and in 1945 was a member of a committee appointed to enquire into various aspects of Veterinary Services and Education, the so-called Adams Committee. In the same year he was a member of the Commission appointed to enquire into the problem of East Coast Fever in South Arfica as a result of the serious recrudescence of the disease in the Vryheid district.

Since the end of the war Dr. du Toit has played a big part in the work of the Food and Agricultural Organization (F.A.O.) established by the United Nations, and has attended meetings of it in Copenhagen, New York, and Geneva. He will continue to be associated with this work in his retirement.

Now that Dr. du Toit has given up his work at Onderstepoort, it does not mean that his services will be lost to agriculture, as he has been appointed in an advisory capacity in the Department of Agriculture. In addition he will retain his membership of a number of boards and committees and will assist in the organisation of the work of the Council of Scientific and Industrial Research.

Insects and Timber:—

[*Continued from page* 147.

Fortunately, the entomologists of the Department of Agriculture have been studying these wood-destroying insects and have devised some very effective methods of controlling them. One of the best methods is to treat all timber with wood-preservatives before it is used for buildings purposes, thus rendering it permanently immune.

It was not an easy matter to find a substance that would penetrate deeply into wood, kill all insects boring in it and would leave a permanent deposit of poison in the pores to protect it from subsequent attack. This has now been accomplished after much painstaking research in collaboration with the Forestry Department. Methods of application are still being improved, but the work has gone so far now that definite recommendations and in some areas regulations can be made, details of which are obtainable.

The ideal would be to treat every bit of timber in South Africa before it is used for building or making into furniture, and if every prospective house owner would see to it that all the timber to be used in his home was so treated, the enormous destruction at present going on would soon be stopped and this problem would soon be solved.

(Dr. Bernard Smit, Principal Entomologist, Pretoria).

Fodder Racks for Sheep.

W. J. Hugo, Sheep and Wool Officer, Grootfontein College of Agriculture, Middelburg, Cape.

ALTHOUGH the sheep farmer depends almost exclusively on the natural grazing for the feed requirements of his animals, there are cases where it is necessary, during a short and sometimes even a prolonged period of drought or grazing shortage, to provide feed for sheep.

Provision must be made for the most economical utilization of feeds, which are usually scarce and expensive, especially where a large number of animals must be fed. This College continually receives enquiries from farmers as to the most suitable means of furnishing the supplementary feed to sheep.

While it is realized that in cases where the necessity for feeding does not often arise, the erection of expensive fodder racks would be uneconomical, it must nevertheless be emphasized that the expense and trouble involved in the construction of an effective and durable fodder rack, is usually offset by the advantages. Poor and cheap fodder racks are in constant need of repair, involving unnecessary expense.

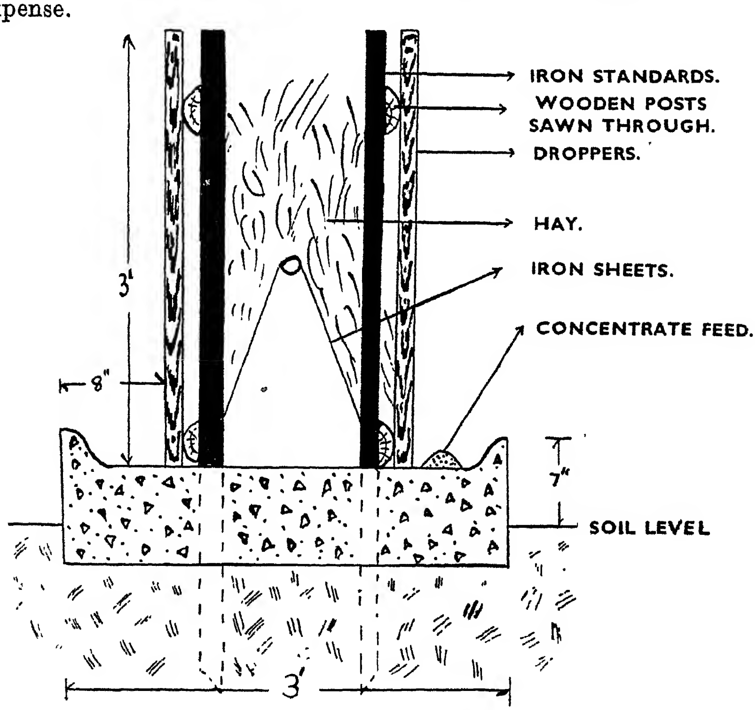

FIG. 1.—Cross-section of combination type of fodder rack for permanent use.

It is not proposed in this article to recommend any one definite type of fodder rack. The writer merely wishes to give some guidance to farmers desirous of introducing such facilities on their farms.

All types of fodder racks referred to in this article are in use at the Grootfontein College of Agriculture. Athough no fodder rack so far designed is a hundred per cent. effective, the racks should at least comply with the following requirements.

(1) *Cleanliness.*—Sheep do not eat soiled feed readily and are especially loth to eat manure-soiled feeds. In any flock of sheep there are always a few which, when fed, are inclined to stand in the

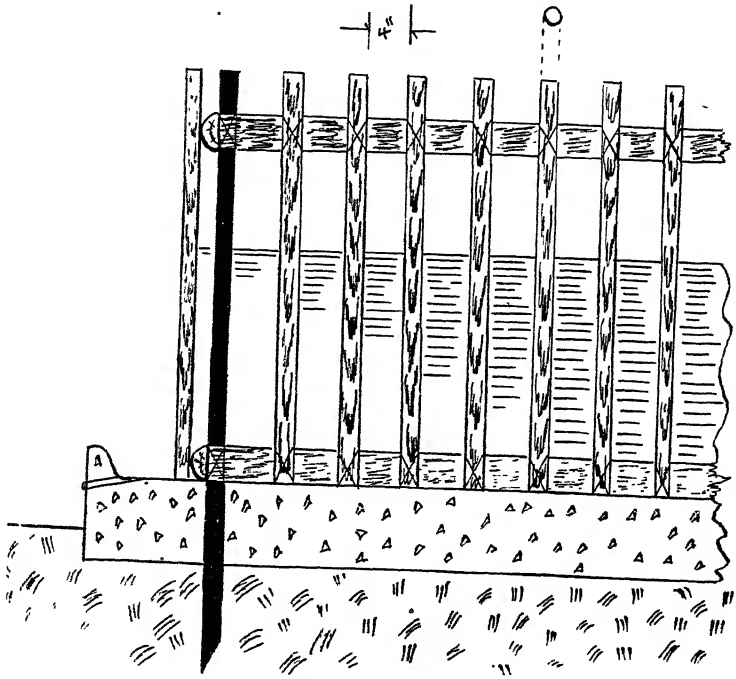

FIG 2.—Side elevation of combination type of fodder rack shown in Fig. 1.

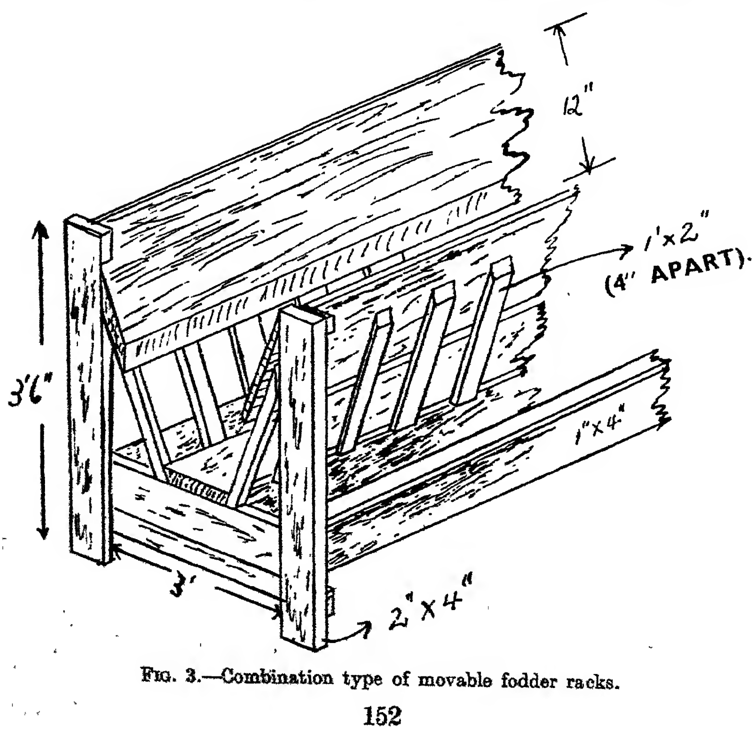

FIG. 3.—Combination type of movable fodder racks.

manger or fodder rack while eating. Thus, in order to prevent trampling and soiling of the fodder through manure and urine, the fodder rack or manger should be so constructed as to obviate the possibility of the animals standing in it. Moreover, the rack should also be so constructed as to ensure the easy removal of old hay or manure.

(2) *Wastage.*—Where sheep receive supplementary feed, it is imperative that wastage should be reduced to a minimum. Wastage is usually caused by the fact that the sheep push their heads into the hay and toss it out. Thus when designing a rack, see to it that the bars are not too wide apart—four inches is a very good width.

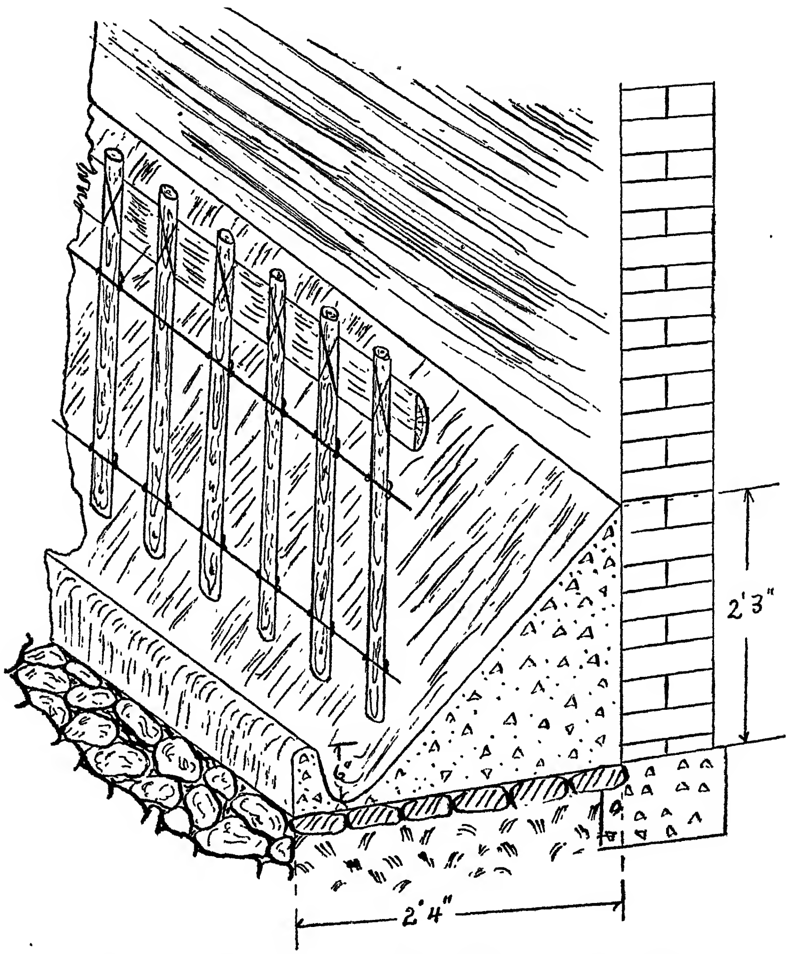

FIG. 4.—Combination type of fodder rack for the ram stable.

The sheep will then not be able to pull large mouthfuls of feed from the rack and waste it by spilling most of it on the ground. There should be a gradual supply of hay but it should not slip through the bars too easily.

(3) *Durability.*—From an economical point of view, durability is a very important point, since constant repairs to fodder racks involve too much labour and expense. Hence, any farmer deciding to construct a fodder rack, would be well advised to use good strong material, once and for all. The rack should be of a simple design, since all kinds of patents will only increase the construction costs.

Treat the wooden poles with creosote or a similar preparation, especially where the poles are planted in the ground.

(4) *Additional requirements.*—The following points are also important:—

(*a*) If it is of the movable type, the fodder rack should not be too heavy.

Fig. 5.—The Ram pens with fodder racks built in.

(*b*) The area around the fodder rack should be effectively drained since trampling of the manure and rotting spilt fodder is unhealthy for both man and beast.

(*c*) The height of the fodder rack should be such that the fodder is within easy reach of the sheep.

(*d*) Sharp, projecting points are liable to injure the sheep and any iron bands and wire must therefore be neatly finished off.

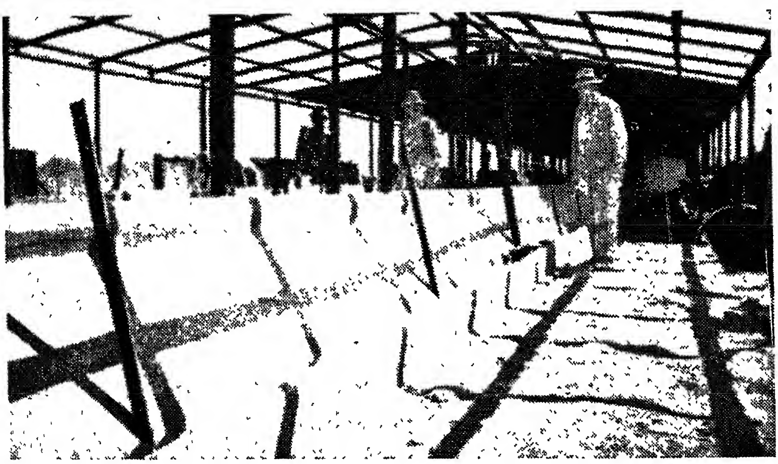

FIG. 6.—Hay racks referred to in Fig. 4 under construction.

(*e*) The fodder rack should be large enough to hold sufficient fodder for one day's feed. Moreover, it should also be large enough to feed a fair number of sheep simultaneously. Standing room of about 1 ft. per sheep should be allowed.

Types of Hay Racks.

The specific design will depend on the particular purpose of feeding. The folder racks of rams are no different from those of ewes or hamels, but the fodder rack for "stabled" rams and/or ewes differs from the type erected as a temporary standby in times of drought. Some fodder racks can hold both hay and concentrates whereas others can hold the hay only, necessitating the separate feeding in a crib of the grain or salt-bonemeal lick. The combination type of fodder rack (in which hay as well as concentrates can be fed) has the decided advantage of preventing to a considerable extent wastage of the leaf portion of the hay, especially lucerne hay. The leaves which become loose and fall off are caught up by the crib portion of the rack where they can be eaten by the sheep.

(1) *Combination type erected for permanent use in a small feeding camp.* (Figs. 1 and 2.) This type of fodder rack gives excellent service. It is both durable and inexpensive. The concrete foundation at the same time serves as a crib for concentrates or a salt lick. It is essential that the foundation should slope slightly on one side to drain off water. The rack may be of any length and is ideal in ram camps where breeding animals are fed regularly.

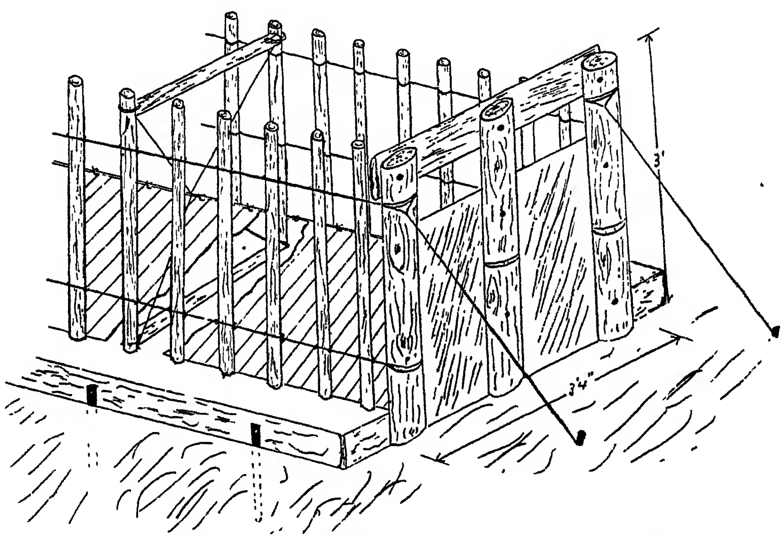

FIG. 7.—A cheap hay rack for feeding sheep in times of drought.

(2) *Combination type of movable rack.*—If manufactured from strong material, this type of hay rack (Fig. 3) can give excellent service since it serves a dual purpose, being at the same time movable and provided with facilities for furnishing a mineral lick and additional feed to the sheep. It should not be longer than about 10 ft. Then it will be light and easily transportable. During the rainy months the construction of some kind of roof over the fodder rack would be advisable.

Combination fodder rack for the ram stable (Fig. 4.) This type of rack is commonly used at the Grootfontein College of Agriculture. It is very effective and is strong and firm. This type of rack is built into the ram-pens shown in Figure 5.

The cement cribs should be 6 in. deep. The droppers, 2 ft. 7 in. in length, are attached to No. 8 wire at intervals of 4 inches. Any leaves or fine stems of the fodder then slide down the slope of the

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Relationship between slow Starters and certain Cheese Defects.

G. Vaandrager, Senior Professional Officer, Division of Dairying.

CONSIDERABLE research work has already been carried out, particularly in New Zealand, on the problem of slow starter cultures in the preparation of Cheddar cheese. This problem is often encountered in South African cheese factories, and is responsible, not only for loss of time in the preparation of cheese, but also for a low quality in the product due to certain defects arising in the cheese.

A cheese showing "fermentation openness" as a result of delayed acid development.

A starter culture which has failed to coagulate owing to a delay in acid development is sometimes referred to as a "watery culture". Defects in the cultures may be due to—

(*a*) their being kept at a low incubation temperature;

(*b*) the use of impure milk, such as milk from the previous evening in the propagation of the cultures; and

(*c*) contamination with bacteriophage.

The first two eventualities are rare and can easily be prevented by the cheese-maker.

What is a Bacteriophage?

Literally, the word bacteriophage, which is derived from the Greek, means devourer of bacteria or bacteria eater. In the absorption or destruction processes denoted by the word "lysis", the bacterial cells are destroyed.

A bacteriophage is much smaller than a bacterial cell and may be regarded as an ultra-microscopic organism which may either exist parasitically on bacteria or may cause a disease amongst them. In some cases the diseased cells recover and in such cases it is usual to speak of secondary growth; such bacteria are resistant to the disease.

Bacteriophaga can easily be inoculated from one culture to another; they are, however, specific in their action. Various strains

of lactic-acid organisms are, for example, readily attacked by various strains of the bacteriophage. Practical use can be made of this fact by interchanging cultures of various origin. Should a certain culture cause difficulties in the cheese vat because of contamination by another strain of the bacteriophage, a different brand of starter may be used. Since all brands of starters do not always contain identical strains of lactic organisms, they will not always react to bacteriophaga in the same manner.

For the same reasons sudden stoppage of acid development is more usual in New Zealand where starters contain only a single strain of lactic-acid bacteria than in South Africa where mixed cultures are used. The bacteriophaga can thus destroy one strain only, but the other strains which are not affected will retard the acid development.

Moreover, a bacteriophage grows much faster than a bacterium, but can only develop in the presence of bacteria, especially young growing cells. By means of dilutions it has been shewn that often as many as 1,000,000,000 bacteriophaga may be contained in a single cubic centimeter of whey. The defect in starter cultures is noticed sporadically and manifests itself most during summer.

Discovery of Bacteriophaga in Cheese Starters.—In 1935 Whitehead and Cox noticed that lactic-acid bacteria in starter cultures are sometimes attacked by bacteriophaga and that aeration of the milk medium may result in a sudden stoppage of acid development as a result of the presence of bacteriophaga in the starter culture. Later (1941) Whitehead and Hunter proved that bacteriophaga may be carried through the air and that aeration may therefore induce direct contamination.

Origin of Bacteriophaga.—Like lactic-acid bacteria, bacteriophaga are probably widely distributed in nature. Whitehead and Hunter are of the opinion that they may remain inactive in dust for long periods and then by chance find their way into milk. As bacteriophaga can develop in the presence of bacteria only, the cheese vat offers an ideal place for their development since in the manufacturing process young cells rapidly develop in the vat.

Bacteriophaga are invariably found in whey, but in the factory their population may be augmented by whey splashes and the residues of whey, in the cheese factory utensils and whey tanks, and on floors which are not kept clean. In the separation of whey in the factory the bacteriophaga are further spread by the air, with the result that cheese vats may be contaminated to an even greater extent. Minor contaminations in the cheese vat are not sufficient to exercise a considerable influence on the cheese-making process. When, however, starter cultures are continually exposed to contamination as is often the case where sterilization is not applied, trouble may be expected.

In South African factories trouble has been experienced with bacteriophaga in a few cases as a result of the use of stirring rods with pipe handles. These pipes were closed up with poor-fitting plugs at the end coming into contact with the whey. In such cases direct contamination of the whey may take place from day to day. The problem was solved by the use of better stirring rods.

Effect of Bacteriophaga on acid development in Cheddar cheese.

In New Zealand and the United States of America carefully-controlled experiments were conducted with cheesemilk which had been contaminated with a definite number of bacteriophaga. It was

found that acid development proceeded normally as long as the curd was still in the whey but that the cheddaring process was delayed as a result of slow acid development. Cheese made of fairly severely-contaminated milk was of second grade quality because of taints which were described as fermented and yeasty. Moreover, the structure was poor and very open owing to the presence of gas in the curd which had failed to develop sufficient acid.

During the past year bacteriophage contamination of starters was definitely established in two South African factories. From records in the factory and from the cheese itself, the following conclusions were drawn:—

(*a*) In one factory a direct contact had been made between the whey separating room and the room in which the starter cultures were kept, by means of a drain pipe. Often the cultures did not coagulate. The cheddaring process often proceeded very slowly in spite of the addition of starter at the rate of 2 per cent. and more. The acid content of whey obtained from cheeses in the press was often as low as 0·60 per cent. Frequently the flavour of the cheese was tainted after a lapse of six weeks.

(*b*) In another factory where bacteriophage contamination could also definitely be detected in starter cultures, the cheddaring process was often delayed for an hour or more, and in such cases the cheese on grading revealed large round holes, described in New Zealand as "fermentation openness". In other factories the presence of bacteriophage contamination could not be established, since all starter cultures had already been destroyed and new ones prepared.

(*c*) All cheese made on seven successive days in May, 1947, was classed as second grade because of the presence of a weed or bush taint. Similar taints often occur in South Africa and the smell of the cheese is similar to that of the well-known weed "kakiebos" (*Tagetes minuta*). The defect suddenly disappeared, but re-appeared after a month and five days' cheese again had to be degraded; subsequently the starter, which was about one year old, failed to coagulate.

The following facts emerge from the available notes on the cheese-making process: It is customary at the factory not to drain the whey until an acidity of 0·22 per cent. has developed. The period between renneting and draining the whey is in the case of inferior cheese about 50 per cent. longer than normal. The acid development in the whey did not proceed uniformly throughout, but remained at an acidity of 0·16 to 0·17 per cent. for a time. Cooking temperatures never exceeded 100° F. and after remaining at a constant level for a period the acidity again rose, but the curd had a distinctly offensive smell. The milk, and the curd, after cutting displayed no taints or unpleasant odours. No data are available on the exact duration of the cheddaring process, but the cheese-maker states that the process was slower and that the curd on being drawn from the hot iron formed shorter threads than usual. With the use of a new starter culture, there was no delay in the manufacturing process, nor were there any taints in either the curd or the cheese.

(*d*) As already pointed out, a poor stirring rod was used in this factory, and during the summer months heavy losses were suffered because of the presence of a strong "kakiebos" taint in the cheese. Trouble with gas was also experienced and in order to rectify this attempts were made to draw the curd at a very high degree of acidity (0·27 per cent.). A typical example is afforded by the following: After a lapse of 2½ hours, an acidity of 0·22 per cent. was noticed in

the whey; half an hour later it rose to 0·25 per cent. and only after another half hour was 0·27 per cent. reached. At this stage, the curd did not have a clean smell. Moreover, the cheddaring process occupied 3 hours and still gave off gas. Press tests were also low, namely, in the vicinity of 0·75 per cent.

A " kakiebos " taint was also recently found in a factory producing Gouda cheese, and this case shows a close similarity to that mentioned above. The acid development in the whey was delayed and as soon as development again set in, the curd developed an unpleasant smell which persisted throughout the ripening process. The accompanying illustration represents a cheese made in another factory and displaying gas development; the pronounced openness is due to delayed gas development. The presence of *Bacillus Coli* in the cheese has also been demonstrated.

Delayed acid development in the cheese vat.

The presence of fruit taint, gassiness and round openings in the texture of the cheese (such as the openings in Swiss cheese—" fermentation openness ") in other cheese producing countries having proved to be due to bacteriophage contamination, it is only reasonable to accept that this condition in South Africa is caused by the same factor.

Weed and " kakiebos " taints are the most serious defects of our Cheddar cheese, and, especially in the case of export cheese, these conditions have been responsible for heavy losses to the industry since 1930. It has not been possible to correlate the presence of " kakiebos " with the origin of the latter defect. In many areas which abound in these weeds the taint is often absent, whereas it has been found in localities where no " kakiebos " grows. The experience of the above factories indicate that bacteriophage contamination may be a vital causal factor. Further investigation in this matter will be undertaken shortly.

In the past, we often endeavoured to find direct causes for the defect, but it seems as if the matter of control may also be approached from another angle, namely, by the indirect method of ensuring a good acid development in the curd without any delays during the whole of the manufacturing process. The conditions under which certain bacteria may cause defects must be rendered so unfavourable for them as to preclude the development of any defects.

Indication of Bacteriophage contamination.

This problem is further complicated by the fact that starter cultures contaminated with bacteriophage often show no outward signs. In the process of cheese-making, " lysis " or destruction of lactic-acid bacteria takes place at a temperature of 100° F. about 2½ hours or longer after inoculation. Starter cultures are kept at a temperature of 70°F. and are not used until from 16 to 24 hours after inoculation. During this period the bacteria recover from the " disease " and produce a normal quantity of acid in the starter. At a subsequent inoculation the " disease " may, however, reappear.

Any of the following conditions must be regarded as indicative of a possible bacteriophage contamination namely, slower progress of the cheddaring process, delay in acid development in the whey, low-pressing tests and the occurrence of short threads on the hot iron at salting, provided the milk had been properly ripened after pasteurization and the cooking temperature had not exceeded 100-102° F. High cooking temperatures may not only harm lactic bacteria, but may also induce slow acid development.

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Lupins for the Improvement of Orchard Soils.

R. J. Goosen, Horticulturist, Joubertina.

THE shortage of fertilizer, especially of nitrogen, during the war, led to the retrogression of all intensively-cultivated soils, particularly orchard soils. Not being an organic manure, fertilizer in itself is not sufficient and consequently the organic matter present in the soil must be supplemented continuously.

FIG. 1.—Seed sown during March. Soil containing the necessary bacteria was scattered in the orchard. No fertilizer was applied.

This can be done in two ways: (1) by the addition of natural manure such as farm manure, bird guano or compost; and (2) by growing some crop or other and ploughing it under.

The first method is excellent but unfortunately there is a general scarcity of these materials—a condition which is aggravated by the mechanization of farming and the effects of soil piracy.

FIG. 2.—Seed sown during March. The seed was not inoculated, nor was any fertilizer applied.

The latter method is attractive, but in the Langkloof area a suitable crop cannot readily be found. Such a crop has to satisfy numerous requirements. Although lupins do not fulfil all the requirements, they have, nevertheless, proved capable of contributing much towards the solution of the fertilizer problem in this area.

In some parts of our country lupin seed does not germinate satisfactorily. In the Langkloof area, however, this difficulty does not present itself in the least, even if the seed is sown very late. If the seed is sown at the beginning of March, the work entailed does not coincide with the busiest period of the fruit season and the crop may yet make sufficient growth to be ready to be

ploughed under towards August. During some years it may be incorporated even later, provided that the work is performed 3 to 4 weeks before the flowering stage is reached and sodium and ammonium nitrates are applied simultaneously.

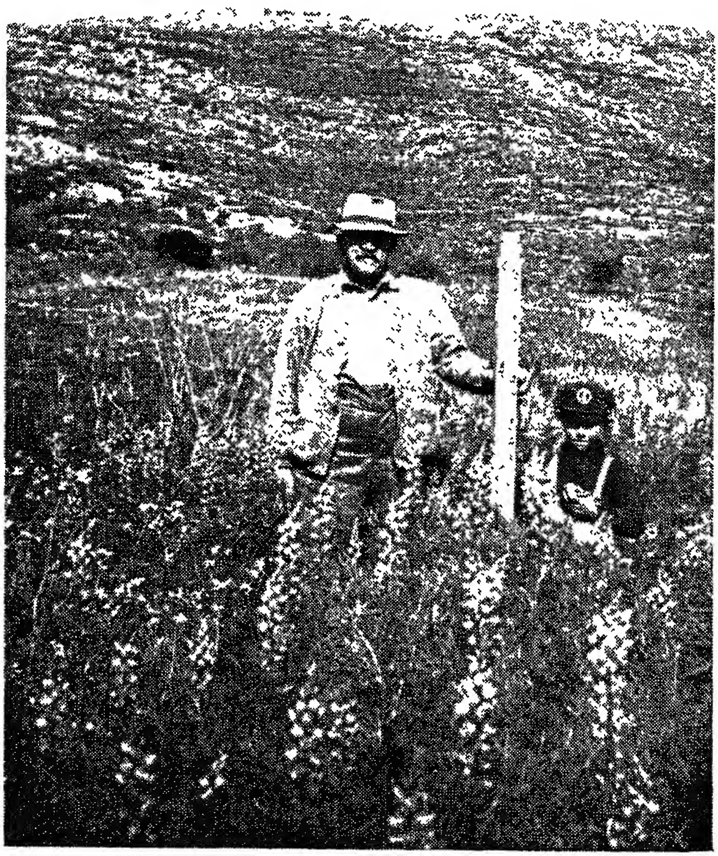


FIG. 3.—Seed sown during March. Soil containing bacteria was scattered in the orchard. No fertilizer was applied.

If lupins are sown for the first time on a piece of land or in an orchard, it is most essential that the seed be inoculated with the necessary bacteria. The method is as follows: The seeds are spread on a hard floor and wetted by spraying with water in which a little glue has been dissolved to render it slightly sticky. The seed may be agitated so as to make the whole mass only slightly damp. Next, fine soil from an orchard in which lupins made good growth and where nodules were definitely known to have formed on the lupin roots is strewn over the seed. Sufficient soil is taken so that the seeds on

being turned, all become thinly coated. Thereafter the seed can be sown, for sufficient bacteria for the plants would have developed.

A more cumberous method consists in taking sufficient soil from the lupin land and in broadcasting it over the land or orchard. Commercial material for inoculating the lupin seeds with the necessary bacteria can be obtained from seedsmen and is also recommended.

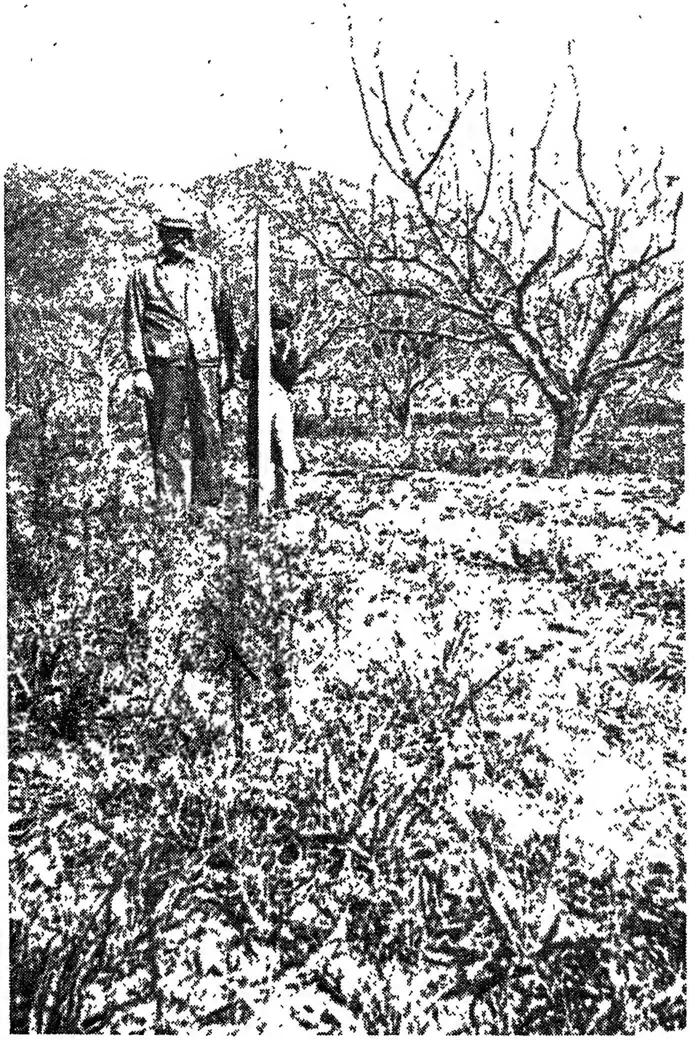


FIG. 4.—Seed sown during March. The seed was not inoculated, and only a small amount of fertilizer was scattered among the trees during the previous season.

Where seeds are not inoculated they will germinate, but the plants will not thrive and may ultimately even die. Lupin seed is expensive and negligence on the part of the farmer may entail heavy financial loss. Inoculation on a definite piece of land is needed but once.

On damp and cold soils it is always desirable to tide the plants over difficult times by the application of a little nitrogenous fertilizer; kraal manure is also suitable. By adopting this practice the

production of a mass of green material for ploughing under at the right time is ensured.

The accompanying photographs speak for themselves. All seeds were sown during the first half of March and the photographs were taken in the middle of August. Nos. 1 and 3 were inoculated by broadcasting soil containing the relative bacteria over the land. Nos. 1 and 2 are adjoining lands; no fertilizer was applied; the soil is poor, being only one foot deep and underlain by a layer of pipe clay containing much gravel and other stones. Nos. 3 and 4 are adjoining lands. The soil has not been fertilized and is shallow, sandy and fairly acid Photo No. 4 is that of a land which had the previous year been treated with a little manure around the trees which fact accounts for the somewhat better appearance of the plants.

The blue, white and pink lupins thrive excellently, but the yellow variety is in all respects poorer in this area. On good soil blue lupins sown at the right time attained a height of more than five feet. Further it may be stated that lupins may also enrich played out lands. In this way the farmer may again obtain seed for green manuring the orchard and at the same time the bare brak land is less exposed to erosion.

Slow Starters and certain Cheese Defects :—

[*Continued from page* 159.

Where the cheddaring process proceeds slowly, cheese-makers often use more starter and this may be most helpful if the starter happens to be contaminated: this procedure should, however, be resorted to only in a case of emergency; it would be preferable to trace the origin of the bacteriophage contamination.

The Incidence of Bacteriophage contamination.

As stated above, the count of bacteriophaga in a cheese factory may be strengthened and whey should be regarded as the source of contamination in such a factory. In order to counteract slow acid development, it is of primary importance to keep all utensils, such as cheese vats, stirring rods, etc., which come into contact with whey, properly clean, and to disinfect them with chemicals containing chlorine (bleaching powder, etc.). In order to keep the atmosphere free from bacteriophaga, it is advisable not to have any whey reservoirs or pig styes too close to the factory. Wind may easily carry contamination from such sites to the factory. The separation of whey should not be affected in the cheese-making room, but rather in a separate room.

Although bacteriophage contamination of milk in the cheese vat may be a cause of delay, the chief obstacles result from the use of contaminated starters. Once starters have become contaminated, it is doubtful whether they can ever again be purified and consequently they should rather be destroyed. The following recommendation merits careful attention on the part of the cheese-maker if starters are to be protected from contamination. Mother cultures should be kept and no cultures should be propagated in the cheese-making room, but rather in special rooms protected against contamination from the air. Furthermore. it is imperative that cultures be handled more carefully and aseptically. The results of recent surveys in factories have also shown that there is much room for improvement, especially in this sphere

Punitive Plants.

S. W. Pienaar, Extension Officer, De Aar, formerly from Griquatown.

NATURE never pauses. Our natural grazing offers striking proof of this premise. Correctly grazed veld should, after benificial utilization, be allowed to grow out fully and run to seed. Grazing has the same stimulating effect on the growth of a plant as pruning on fruit trees. Nutritious plants are grazed right down and new growth and seed production are therefore regularly stimulated. For this reason judicious grazing will improve veld.

Farmers contend that if veld is spared too long, it becomes sour. What actually happens is that palatable plants are smothered under the accumulating dead vegetable matter and are superseded by inferior plants which usually grow densely and luxuriantly.

But continuous grazing gives stock the opportunity of keeping the palatable plants short, thus preventing the building up of reserve nutrients from which the root system can be strengthened and seed produced. Consequently, these palatable plants gradually weaken and finally die.

Overgrazing accelerates this process and literally results in the exposure of the soil to erosion in all its terrible forms. The exposed soil is then overrun by inferior plants, many of which are noxious and even poisonous. These plants may rightly be called *punitive plants*.

As long as only annual crops intrude, the danger is not so great, since their control is relatively simple. In the case of pirate shrubs and trees, however, the question becomes very serious, since in most cases, they have to be cut down at a considerable expense.

The punitive plants found in Griqualand West are limited to a few families. Species within those families are equally limited, but in many cases they become so prominent that they constitute an imminent danger to the future.

Three main soil types are found in the Griqualand West area, viz., lime, red dolomite and sandy soils. Since the vegetal covers of each of these soil types differ radically, one punitive plant from each of the three groups will be discussed.

1. "*Haakdoring*" or "*Swarthaak*". (*Acacia detinens*).—Although this shrub constitutes one of the most useful fodder trees of Griqualand West, and is protected by law against eradication, it can be regarded as an actual pirate plant in many cases. It occurs mainly in the form of a shrub, especially where it has been grazed down too severely or previously cut down. The soil type also seems to influence the way of growth in some parts.

"Haakdoring" occurs in large numbers on red soil and sandy loams of dolomite origin. On the red dolomite ridges the vegetal cover is usually limited to only "haakdoring", "driedoring" and "kapokbossie", other plants having been trampled out.

By rapid propagation the plant forms impenetrable plantations. Random counts showed cases where three to eight small plants occurred per square yard. If only half of these develop to the shrub stage, those places will be impenetrable to stock. Already impenetrable patches such as these are frequently found against the slopes of mountains and ridges. It is interesting to note that perennial grasses such as redgrass and finger grass occur within such self trotecting patches.

Cutting the bush down as a control measure only aggravates the position, since the bush then develops anything from four to eight stems instead of one. Permanent eradication is possible only if the plant is removed root and all, and this involves considerable expense.

"Haakdoring" seeds have hard husks and do not germinate easily unless exposed to the direct rays of the sun. If, by judicious grazing control, the vegetal cover increases to such an extent that the area is again densely covered, further propagation of "haakdoring" will be stopped.

Unless, therefore, grazing control is applied in the near future, "haakdoring" which, in its shrub form, constitutes a valuable fodder tree in Griqualand West, will become one of the most dangerous pirate plants in the area.

(2) *"Vermeersiektebossie"* (*Geigeria passeriniodes.*).—This well-known poisonous plant which has already caused farmers losses in small and large stock amounting to thousands of pounds, occurs mostly on the lime soils of the Ghaap highland. It is also found on the red dolomite soils, but to a far lesser extent, even where the dolomite veld is more severely trampled than the lime veld.

Fortunately, it is mainly the less poisonous type, viz. *Geigeria passerinoides* which occurs in Griqualand West. The most poisonous species, viz. *Geigeria aspera* does not occur at all. The writer of this article has never personally encountered *Geigeria Zeyheri* and *Geigeria passerinoides.*

The assertion of farmers that *Geigeria passerinoides* in moderate quantities is an excellent feed for suheep, can be corroborated by personal observation. Since 8 to 10 lb. of "vermeerbos" is required to kill a sheep, it is clear that this plant is dangerous only if it constitutes the animals' sole feed.

On everely trampled veld grazing, overrun by "vermeerbos", the mortality among sheep is high. The mortality in a flock has been known to be as high as 73 per cent. This shows the serious measures to which nature will resort in this area in cases where trampling is caused by mismanagement and overgrazing.

One of the most striking results obtained at the Koopmansfontein Pasture Research Station is the definite relation between the density of the vegetal cover on the veld and the numbers of "vermeerbos" present. As palatable plants disappear as a result of trampling, "vermeerbos" sets in.

Thus, as soon as a farm becomes overstocked and threatens the normal stand of the vegetation, the pirate plant, "vermeerbos", acts drastically and thins out the stock.

(3) *"Wilde-ui"* or *"Malkop-ui"* (*Dipcadi glaucum*).—This poisonous plant of Griqualand West shows a decided predilection for sandy soils. In the sandy square between Kimberley, Douglas, Belmont and Schmidtsdrif very heavy stock losses were suffered due to "malkop-ui" poisoning after the summer rains of 1946. These losses actually exceeded those suffered during the 1944-1946 drought. Trampled farms especially were severely hit.

Like the "vermeerbos", the "wilde-ui" is dangerous only if eaten in too large quantities.

The increase of "wilde-ui" is in direct proportion to the extent to which a farm is trampled. Many cases are known where the boundary between farms also forms an obstruction to this poison plant. On the side where fairly systematic veld conservation is applied, a few scattered plants occur, whereas on the other side,

 [*Continued on page* 168.

Napier Fodder as a Feed.

J. W. Mostert, College of Agriculture, Potchefstroom.

ONE of the most serious problems, usually facing stockfarmers is the absence of a good perennial pasture crop. More often than not grazing supplied by natural veld is insufficient, especially if high-producing animals are kept. In most cases provision has to be made for grazing with a high nutritional value or else feeds have to be procured at high prices.

Already several excellent annual pasture crops are occupying an extremely important place in our farming systems.

There are, however, portions of the farm which can be successfully planted to a perennial, e.g.. those which, because of their marshiness or susceptibility to erosion or perhaps the need for building up their fertility, cannot be worked annually.

Results obtained at the Potchefstroom College of Agriculture, have shown that Napier fodder ranks amongst those perennial grasses and crops which can occupy an important and useful place. The reason why this grass has not yet gained a prominent place in our farming systems is probably lack of attention coupled with the fact that is is used at a wrong stage of development.

Properties.—Napier fodder closely resembles young kaffircorn plants. It is a broad-leafed, thick, juicy-stemmed perennial having a strong and extensive root system with which it binds the soil, improving the structure and increasing the fertility. The plant adapts itself to most soils and can be successfully grown in vleis and on ridges. Moreover, it can be profitably grown under dryland conditions in areas with an annual rainfall of 23 inches.. Under irrigation the grass makes rapid growth and is capable of reaching a height of 5 feet within a month. Napier fodder is damaged by the first frost, but sprouts again in early spring. It grows very actively until late in autumn.

Nutritional Value.—It is not always realized that good young grazing represents the cheapest source of animal feed and that generally speaking, it is as rich as, or even richer in digestible nutrients than many of the high-priced commercial feeds. Analyses and digestibility tests have shown that the grass has a high nutritional value, especially if used as a green pasture.

At the young stage of development i.e. when the grass is about 3 feet high its protein content is as high as 17 per cent. As the plants attain a greater height, however, the protein content gradually diminishes until at the height of 8 feet, the protein content is only 8 per cent. The fibre percentage is low while the plants are young; gradually increasing as they grow older. The grass is relatively high in digestible proteins *viz.* 68 parts to 100 parts of dry material while it is still young; these diminish fairly rapidly, however, as the plants grow older. The mineral and vitamin content of the plant is also reasonably high.

Uses and Establishment.—Napier fodder is eminently suitable for grazing especially in the young stage, and has a fairly high carrying capacity. Since its nutritional value is highest while it is young, grazing should take place at this stage. Continuous heavy grazing at the early stage carries the risk of an adverse effect on the growth

and stand. Consequently the application of a rotational grazing system is necessary, if the plants are to recover before the next grazing.

In addition to its uses as a grazing crop, the plant also lends itself to ensiling. During the first year of its establishment a Napier fodder stand of one morgen yielded 14 tons of silage material together with an aftermath pasture. For silage it is cut at an average height of more or less 7 feet. It can be ensiled with or without molasses.

Furthermore, the grass is also suitable for hay. It is somewhat coarse and has to be cut, in which condition it is most eagerly eaten by animals.

Napier fodder is further valuable in that it can be planted on contour banks and strips for erosion control. At the same time it yields large quantities of plant material which is a valuable animal feed.

Napier fodder comprises several valuable species. As a feed the broad-leafed species such as "Gold Coast" and "Niagara Falls" are the most suitable, whereas Umtali has a more erect-growing habit; its further features are long erect stems and long narrow leaves which render it particularly suitable for wind breaks.

Since the grass requires a long growing period for seeding and the summers in the Union are too short, propagation should be effected mainly from roots. Ten bags of roots are sufficient for planting 1 morgen in rows 5 to 6 feet apart at an espacement of 3 feet, provided the roots are broken into pieces. Good, mature stalks or stems may also be broken up into pieces of a few inter-nodes and put into the soil as slips.

For obtaining a good stand planting should be carried out on thoroughly wet ground and the plants should be properly compacted by trampling. It is necessary to plant in wide rows spaced more or less 5 feet apart so as to allow of cultivation and fertilizing between the rows. An application of either kraal manure or superphosphate will greatly increase the yield.

Roots for planting can be obtained from most of the colleges of agriculture and agricultural research stations and also from private nurseries and farmers.

Punitive Plants :—

[*Continued from page* 166.

the poison plant thrives prolifically on the trampled veld. Cases have been found where these plants showed such an increase that the tubers were literally levered from the soil by one another. In such extreme cases 14 plants occurred per square yard.

In a forsaken cementery, which was fenced in, a dense, luxuriant grass cover developed. No "wilde-ui" was found in this old cementery, whereas it constituted practically the only vegetal cover in the immediate vicinity.

In these Sandveld areas sub-division of farms was carried out in a large percentage of cases to uneconomical units, viz. to sizes of 500-800 morgen. Since a sandy farm is easily trampled, and the farm units are too small in many cases, the importance of this poison plant is thrown into relief.

Like the "vermeerbossie" therefore, the "wilde-ui" will see to it that the correct proportions are maintained between the number of animals and the available vegetation.

Climatological Study on Sheep in the Karroo.

S. W. Bosman, Assistant Professional Officer, Grootfontein College of Agriculture, C.P.

IN view of the restricting effect of various physical factors on the successful development of crop farming in South Africa, the writer wishes to endorse the views expressed by Leppan(1) viz., that any sound agricultural policy in this country should have as its basis animal husbandry, with crop production as a supplement to the natural grazing.

For successful animal husbandry, however, fodder production is of paramount importance especially under irrigation farming and, in addition, special attention should be given to the breed and type of animal best suited to its environment and capable of making the most profitable use of the fodder production. Of special importance in this connection are irrigation schemes, the production of an adequate feed supply being virtually ensured by the elimination of the fatal effects of periodic droughts.

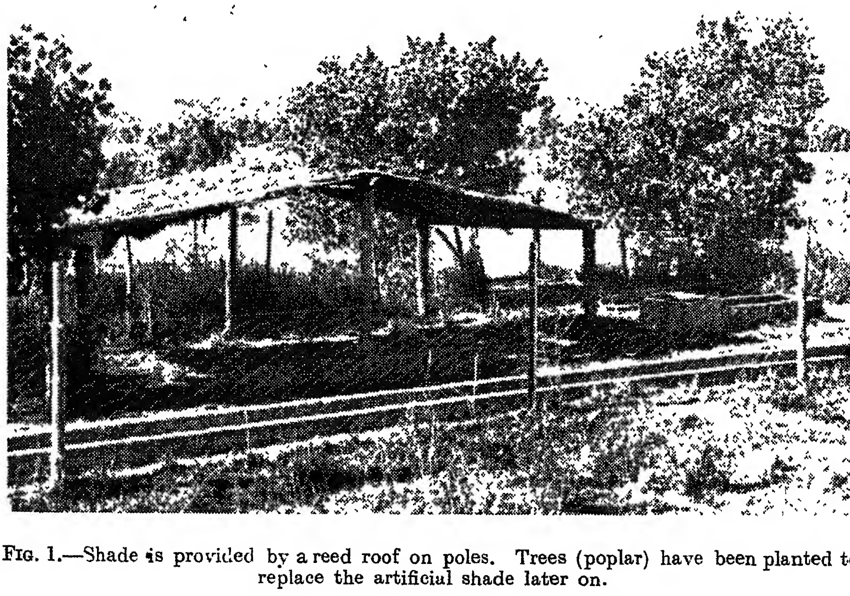


FIG. 1.—Shade is provided by a reed roof on poles. Trees (poplar) have been planted to replace the artificial shade later on.

Under the irrigation schemes intensive stock production only will be possible. Highly bred animals, capable of converting the available feed into an edible product as rapidly and as advantageously as possible, will enjoy preference. Examples of such animals are the dairy cow, the pig, the fat lamb and the beef ox.

Since, however, in many cases irrigation farming is possible only in areas with high temperatures, it will be necessary for the animals to adapt themselves to such conditions, if they are to give the best results.

As regards sheep farming in the Union, Bonsma(2) demonstrated clearly that the prices of our wool are subject to a far greater extent

to fluctuations than those of say, New Zealand export lamb. With the modern tendency towards a higher demand for agricultural products of a better quality, it may be expected that by degrees a greater differentiation will be made in future between the prices of mutton and lamb. Not only is the quality of lamb superior to that of mutton, but the smaller joint is also more popular. Lamb owes its fine texture and tenderness to the fine fibre and the good distribution of fat inside the fibres and for this reason it is very much more popular than mutton from a full-grown Merino or the Blackhead Persian, with its coarse and tough fibres and poor fat distribution.

Since this country will have to compete with the established market of other export countries such as New Zealand and the Argentine, the eminent suitability of the fat lamb for the oversea market deserve special attention. Thus, with a view to establishing whether the breeding of mutton sheep, and more especially of fat lambs will be profitable under our high temperatures, experiments were carried out at the Grootfontein College of Agriculture to determine the influence of sun and shade on the grazing habits and weight increases of mutton breeds. The research was focussed mainly on imported breeds and crosses from such breeds, since experience and later experimental results have shown that highly bred and high producing animals developed for many generations under ideal feed conditions in the temperate cool climate of Europe, adapt themselves very poorly to tropical and subtropical climatic conditions. It was found in the south-western portions of the United States of America that degeneration takes place in pure-bred beef-cattle breeds and the methods applied for developing a breed which will adapt itself to the climate and rigorous external conditions are described by Schutte(3). The disturbance of the physiological functions of cattle by unfavourable climatic conditions were experimentally determined by Rhoad(4) and by Bonsma(5).

In connection with the effect of high environmental temperatures Rhoad(4) writes as follows:—

"(1) As the external temperature rises above the critical temperature, the animal organism facilitates the elimination of body heat by physical regulation in an endeavour to maintain normal body temperature.

Physical regulation is effected by radiation and conduction of heat from the skin and elimination of heat as latent heat of water vapour from the skin and lungs. All three function simultaneously at all temperatures, however, as the external temperature rises, a greater part of the temperature control passes . . . to the lungs. As the external temperature rises above the upper limit of physical regulation, heat is retained in the body and body temperature rises as a result. This in turn increases cellular activity with a corresponding increase in heat production and loss of energy.

(2) With increasing high air temperatures the burden of physical regulation . . . is forced upon the lungs, which, accelerating their rhythm, eliminate increased quantities of the end-products of katabolism, heat, carbon dioxide and water.

(3) Apart from increased metabolism at high temperatures there is an increase in heat production . . . due to . . . various processes of physical regulation.

(4) The thermal environment may also increase metabolic rate of animals through the condition of the atmosphere as regards moisture and sunlight. Rubner has shown how high moisture content

of the air, relative humidity 60 per cent., may increase considerably the metabolism in dogs and other animals by lowering the rate of evaporation of the water given off from the lungs and skin. In this way high humidity lowers the upper limit of physical regulation.

(5) Direct sunlight may impart a considerable amount of heat to the body which in addition to high temperature and humidity in the Tropics causes considerable discomfort and loss of energy if shade is not provided.

(6) That long and dense hair coat is detrimental to physical regulation at high temperatures, is evident as it hinders both radiation and conduction of heat from the skin. "

Rhoad([4]) also quotes that Forbes and his co-workers proved that a steer, of which the thick winter coat of hair had been clipped, could offer a better resistance to heat than one with long hair. This proves that clipping hair raised the upper limits of the physical regulation of the body temperature.

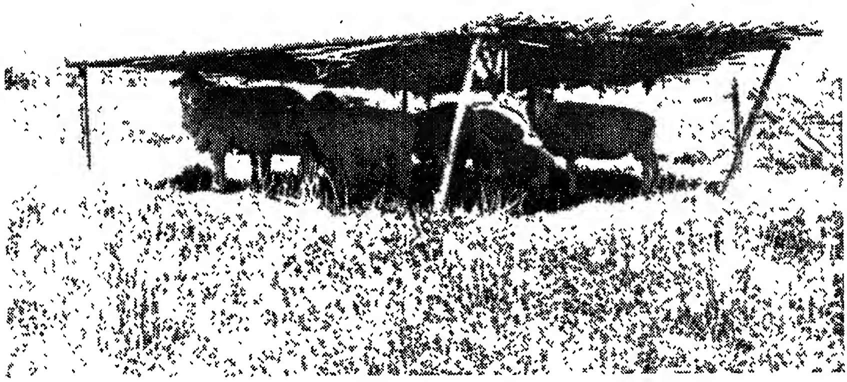


Fig. 2.—A moveable shelter. It is used by the ewes and lambs on a hot day.

From the above and from further experiments carried out by the above workers, it is clear that an imported cattle breed developed under ideal feed conditions in the temperate climatic regions shows a poor adaptation to its environment when bred in tropical regions. Thus, although sufficient feed is provided, a large portion of the animal's energy is used for the physical regulation of its body temperature only, which means that the animal is virtually "starved" in spite of an abundance of feed. This result is reflected not only in poor production (such as a low milk yield), poor beef qualities and late maturity, but also in poor resistance to disease. The latter is of special importance in South Africa which is noted for its multiplicity of stock diseases and poisonous plants. An animal in poor condition will be more inclined to eat poisonous plants than one in good condition.

It is noteworthy that considerable work has been carried out on cattle in regard to the influence of climatological factors, but very little on sheep. Best known as research workers in the latter connec-

tion are probably McKenzie and Berliner(6) who determined degeneration of fertility in Hampshire and Shropshire rams kept in a room at a temperature of 26° to 35° C. Abnormal sperms were produced, and differences in individual reactions were noticed, viz. that certain rams were more susceptible to the detrimental effect of the unfavourable climatic conditions than others.

Gunn(7) and his co-workers expanded on the above work in Australia on Merino sheep. Under artificial high temperatures and dry atmospheric conditions a detrimental effect was obtained on spermatogenesis. The intensity of this degeneration was in proportion to the time during which the ram was subjected to these conditions. The same type of abnormality was found under natural conditions during the dry hot seasons occurring annually in Australia.

In a study on the reactions of sheep in hot atmospheres, Lee and Robinson(8) established that, compared with other domestic animals, sheep have an exceptionally high resistance to such atmospheres. It was found, however, that from 90° F. the sheep maintained their body temperature with difficulty. The respiration is accelerated, rising to above normal when the temperature in the room in which the sheep are kept increases from 85° F. with 35 per cent. humidity and to as high as 240 per minute at 110° F. These research workers also found that the ingestion of water causes a certain drop in the body temperature but that no further changes take place in the reactions of the sheep.

Below are the results of experiments carried out at Grootfontein in connection with the effect of climate on certain physiological, ecological and production functions in sheep.

A. Effect of Atmospheric Temperature on Body of Different Sheep Breeds and Crosses.

The object of the first portion of this experiment was to determine whether external temperature has any effect on the body temperatures of sheep and whether there are any differences in the resistance of breeds to abnormally high temperatures. According to experiments(5) carried out with cattle, it is clear that any disturbing influence of high temperatures is immediately counteracted by physical phenomena such as accelerated respiration, increased heart action and the secretion of saliva and the efficacy of these counter measures is reflected in the body temperature of the animal. Differences were noticed in the ability of different breeds to neutralize the effect of unfavourable, high climatic conditions.

The following sheep breeds were compared: Blackhead Persian and Merino as "indigenous" breeds, the Dorset Horn and the Border Leicester as exotic breeds and the Dorset Horn × Merino as a cross between the "indigenous" and exotic breeds.

Mature dry ewes were used throughout. They were kept in separate groups, in small camps of 14 by 16 yards. Each camp was provided with an iron shelter of 12 by 16 ft. containing a hay rack in which lucerne hay and maize were fed. Water was provided in a cement drinking trough.

The average body temperatures of the above breeds are graphically represented in graph 1. These temperatures were taken on three different days in order to show the influence of the external temperature on body temperature, viz., on days when the maximum atmospheric temperature rose to 58° F., 73° F. and 98° F., respectively.

The average maximum and minimum body temperatures are reflected by the following table.

TABLE I.—*Sheep Breed Types.*

Maximum Atmospheric Temperature in Shade.	Blackhead Persian.		Merino.		Dorset Horn.		Border Leicester.		Dorset Horn x Merino.	
	Max. body temperature.	Min. body temperature.	Max. body temperature.	Min. body temperature.	Max. body temperature.	Min. body temperature.	Max. body temperature.	Min. body temperature.	Max. body temperature.	Min. body temperature.
	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.
58° F..........	102·6	99·4	102·2	100·4	102·9	102·9	102·9	102·5	102·9	102·2
73° F..........	103·5	101·6	103·5	101·8	103·8	103·0	104·0	102·4	103·6	102·1
98° F..........	103·6	101·1	103·5	102·6	104·3	103·2	105·2	103·7	104·3	103·2

From graph 1 and the above table, the following can be seen:—

(*a*) On the coolest day (max. temperature in shade 58° F.) there was no significant difference between the average maximum body temperatures of the various breed types. The average maximum body temperatures of the Blackhead Persian and the Merino were, however, slightly lower than those of the other breed types. As regards minimum body temperatures, the same tendency was noticed, but the difference was more marked.

(*b*) On the moderately warm day (73° F.) higher body temperatures were observed throughout. Here again the rise was highest in the exotic breeds and the exotic half-bred type.

(*c*) On the hottest day on which the observations were made (98° F.) a further general rise was noticed in body temperatures. Here especially the high body temperatures of the exotic and half-bred types are striking.

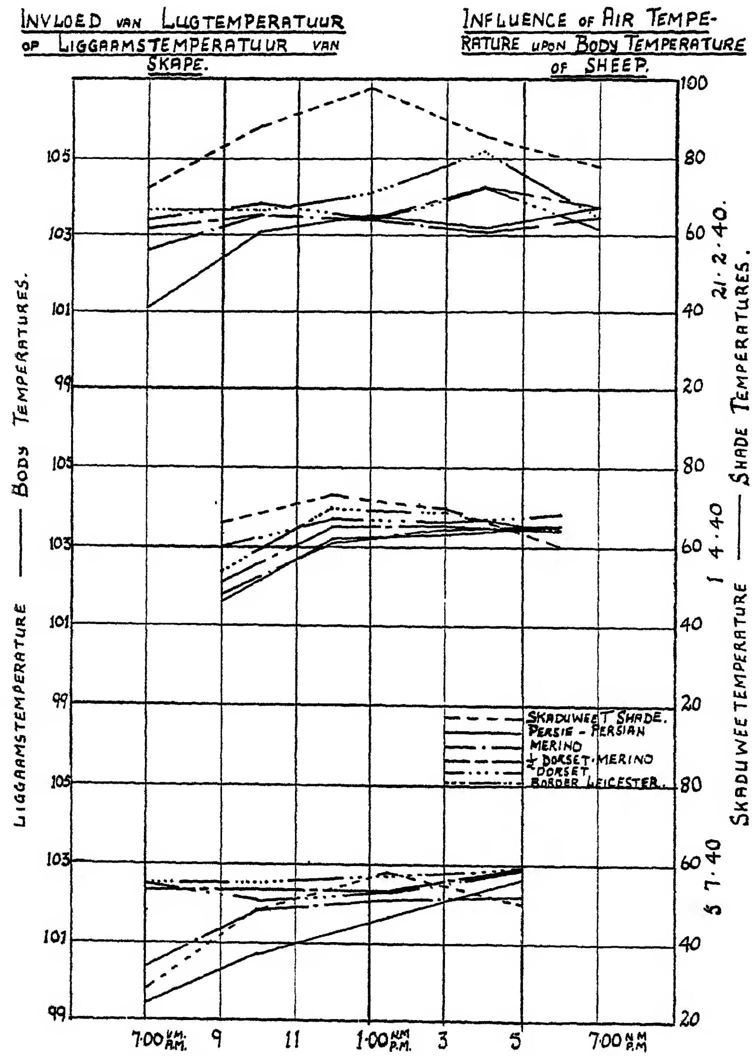
The above leads to the conclusion therefore that the body temperature of the sheep is influenced by the external temperature. Even at an atmospheric temperature of 73° F. there is already a rise in body temperature and at an atmospheric temperature of 98° F. the rise is striking, being the highest in the exotic breeds and the exotic half-bred types and lowest in the Blackhead Persian and the Merino.

B. Effect of Climate on Grazing Habits of Lambing Ewes on Irrigated Pasture Crops.

The grazing habits of cattle were investigated by several research workers. Johnstone-Wallace and Kennedy(9) found that Aberdeen-Angus and Hereford cows grazed actively on good grazing for 7 to 8 hours out of the 24, irrespective of the length of the grass. About 60 per cent. of the grazing takes place during the day, a distance of about two miles being covered and about 40 per cent. of the grazing takes place at night, a distance of about half a mile being covered. The animal lies for 12 hours, and ruminates for 7. Water is drunk in the late afternoon and the calves suckle three times a day—for 15 minutes at a time.

Atkeson[10] and his co-workers found that dairy cows kept on pastures for 11 to 12 hours, grazed for a little less than half the time when the quality of the pasture was good. On poor pasturage 62 per cent. of the time was taken up by grazing, and on moderately good grazing 56 per cent. of the time. The cows drank water from three to four times a day, irrespective of the quality of the grazing.

GRAPH I.



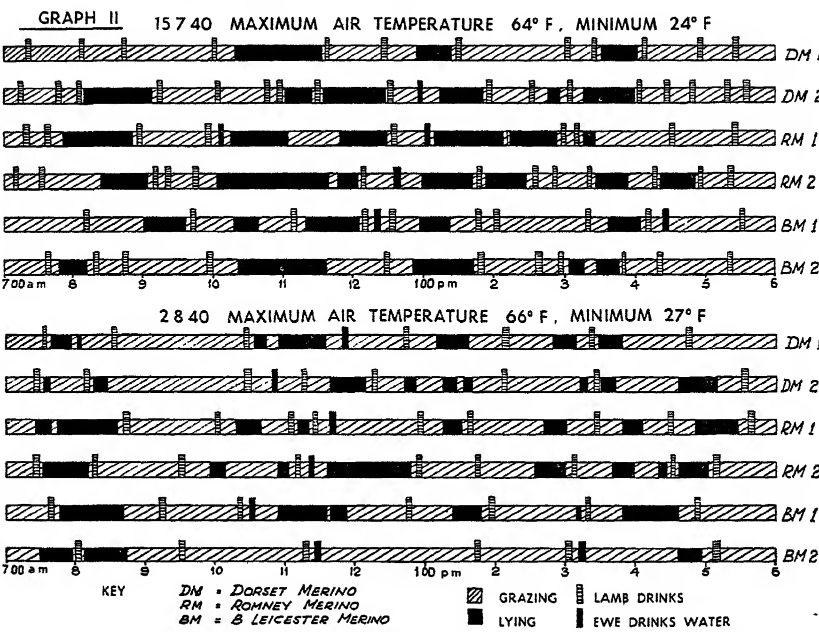
Over a period of 24 hours it was found that during the day 40 per cent. of the time was taken up by grazing, and during the night 16 per cent. For 35 per cent. of the day and for 80 per cent. of the night the animals were lying down.

Seath and Miller[11] found with 3 Jersey and 3 Holstein cows that over a period of 24 hours cows graze for less than 2 hours during the day (on fairly hot days), but that they graze for 5·5 to 5·7 hours during the night. On cool days 2·4 as much time is taken

up by the grazing than on hot days. This finding stresses the desirability of the provision of good grazing during the night as well.

The writer is unaware of any research work carried out on the grazing habits of sheep.

These observations were also designed to determine whether there are certain times of the day when the sheep are mainly grazing, standing or lying and how much use is made of shade on hot and cool days. If at certain times of the day there is a lull in the grazing activities then sheep should be run on irrigated pasturage during the periods of active grazing. Wastage from trampling will be obviated thereby if shade is provided for the inactive periods, the sheep can stand peacefully without expending any unnecessary energy in walking—a state of affairs which will aid the body's function of regulating its own temperature.



N.B.—15 7 40 and 2 8 40 should read 15 July, 1940 and 2 August, 1940.

Grazing observations were made on merino cross ewes (Dorset Horn, Border Leicester and Romney Marsh crossed with the Merino) every ten minutes from sunrise to sunset in regard to:—

(1) The number of sheep grazings, the number standing in the sun or in the shade and the number lying in the sun or in the shade (shade was provided by trees).

(2) The temperature in the shade of the trees.

Grazing was provided in the form of lucerne in summer and wheat in winter.

Observations of the grazing habits of 6 individual ewes and lambs, representing the three types of ewes, were carried out for two days and full records made of periods of grazing, standing, lying or drinking of each ewe as well as of the times when the lambs were suckled. These details were recorded only on two days when the ewes were on winter grazing, viz. on 15th July, 1940, when the

lambs were from 1 to 7 days old and on 2nd August, 1940, when the lambs were 18 days older. These data are represented in graph II.

The following facts emerge from this graph:—

(1) On 15th July, 1940, the lambs were suckled on an average of 12 times during the observation period of 11 hours, the numbers varying from 9 to 17 times per lamb. On 2nd August, 1940, the average was 7·6 times, the numbers varying from 6 to 9 times per lamb.

(2) On 15th July, 1940, the ewes lay down for an average of 2½ out of the 11 hours—the time taken up varying from 40 minutes to 286 minutes. Thus the average percentage of time spent in a recumbent position was 22·7 per cent. The rest of the time was devoted to grazing, walking and standing. On 2nd August, 1940, the 6 ewes reclined for an average of 44 minutes (21 to 92 minutes per ewe) or 6·7 per cent. of the time.

(3) The ewes usually drank between ten o'clock and one o'clock—generally only once a day.

(4) Grazing took place at intervals practically the whole day. It should be noted that these observations were carried out on two fairly cool days and on abundant green succulent grazing, which may account for the small quantity of water consumed by the ewes.

The above preliminary observations were carried out on the six ewes in respect of the more essential details of time to serve as a guide. After that, the observations on large sheep were carried out simultaneously and the numbers grazing, standing in the sun or in the shade and lying in the sun or in the shade, were recorded every ten minutes. The percentages for the various activities are given in Table II and the data for a fairly cool day as opposed to a fairly hot day are represented in Graph III. The number of ewes in the various groups varied from 27 to 54 and the grazing consisted of lucerne or wheat. Plenty of grazing was available in both cases and drinking water too, was always provided. In Graph III the numbers are represented as percentages and the observations grouped into convenient periods.

Table II and Graph III reflect the following:—

(1) The sheep grazed for the major portion of the day, the time taken up by grazing varying from 54·71 to 62·22 per cent. of the total period during which the observations were carried out.

On cool days the sheep grazed uniformly, practically throughout the day. On hot days, however, they were inclined to graze mainly during the cool morning and late afternoon. Only short periods of intensive grazing were observed during the heat of the day.

(2) The observations show that standing takes 13·8 to 22·65 per cent. of the whole day. It is important to note that during the hottest parts of the day sheep mostly stand in the shade and on cool days or during cool periods of the day, in the sun.

(3) According to the observations, the sheep lie for 20·9 to 28·2 per cent of the time. The ewes lie mainly in the shade.

The conclusion drawn from the above is that the sheep tend to graze all day if the temperature is favourable. If, however, the temperatures are high, they graze mainly during the cool parts of the day.

During the hotter periods of the day they tend to seek out the shade.

TABLE II.—*Analyses of Grazing Observations on Sheep.*

Period.	Percentage of Total Time taken up by:					Average temp. for period.	Maximum temp. for day.
	Grazing.	Standing.		Lying.			
		In Sun.	In Shade.	In Sun.	In Shade.		
Date: 15.7.40.—*Group:* Winter Crop Pasturage.							
						° F.	
7.30–9.30 a.m.......	79·8	10·2		10·0		37·0	
9.30–11.30 a.m......	40·6	25·0		34·4		56·5	
11.30–1.30 p.m......	45·4	15·6		39·0		61·5	64° F.
1.30–3.30 p.m.......	48·1	15·6		36·3		64·0	
3.30–5.30 p.m.......	73·1	15·6		11·3		58·5	
FOR WHOLE DAY.	55·5	20·6		23·9		—	
Date: 2.8.40—*Group:* Winter Crop Pasturage.							
6.50–9.30 a.m.......	59·5	21·0		19·5		31·7	
9.30–11.30 a.m......	39·4	11·4		49·2		48·9	
11.30–1.30 p.m......	49·8	8·3		41·9		56·2	66° F.
1.30–3.30 p.m.......	65·4	17·3		17·3		63·8	
3.30–5.50 p.m.......	62·7	24·1		13·2		55·7	
FOR WHOLE DAY.	56·2	16·9		26·9		—	
Date: 6.9.40—*Group:* Winter Crop Pasturage.							
6.50–9.30 a.m.......	68·4	4·1	0·0	27·5	0·0	45·0	
9.30–11.30 a.m......	58·3	7·4	12·7	3·7	17·9	60·8	
11.30–1.30 p.m......	42·6	0·9	29·3	3·4	23·8	66·8	
1.30–3.30 p.m.......	63·0	3·7	17·3	6·2	9·8	72·3	76° F.
3.30–5.50 p.m.......	65·3	22·8	0·3	11·6	0·0	69·4	
FOR WHOLE DAY.	60·4	8·0	10·7	11·8	9·1	—	
FOR WHOLE DAY.	60·4	18·7		20·9			
Date: 3.10.40—*Group:* Winter Crop Pasturage.							
6.40–9.30 a.m.......	37·2	6·0	11·1	4·9	40·8	66·0	
9.30–11.30 a.m......	29·8	11·5	17·5	11·2	30·0	74·3	
11.30–1.30 p.m......	62·2	13·1	3·5	17·9	3·3	79·0	
1.30–3.30 p.m.......	59·4	18·3	0·0	22·3	0·0	78·5	80° F.
3.30–6.10 p.m.......	72·6	19·0	0·0	8·4	0·0	77·0	
FOR WHOLE DAY.	52·0	13·2	6·4	12·0	16·2	—	
FOR WHOLE DAY.	52·0	21·2		28·2			
Date: 3.12.40.—*Group:* Lucerne Pasturage.							
6.0–9.30 a.m.......	64·0	7·6	4·7	14·3	9·4	64·2	
9.30–11.30 a.m.....	26·0	2·9	25·5	1·3	44·3	78·8	
11.30–1.30 p.m.....	35·6	5·7	18·2	0·1	40·4	85·4	
1.30–3.30 p.m......	87·2	3·7	1·0	6·0	2·1	82·2	88° F.
3.30–6.0 p.m.......	90·8	1·0	1·9	5·6	0·7	80·3	
FOR WHOLE DAY.	62·2	4·2	9·6	6·1	17·9	—	
FOR WHOLE DAY.	62·2	13·8		24·0			

TABLE II—(*continued*).

Date: 30.12.40.—*Group:* Lucerne Pasturage.

Period.	PERCENTAGE OF TOTAL TIME TAKEN UP BY: Grazing.	Standing. In Sun.	Standing. In Shade.	Lying. In Sun.	Lying. In Shade.	Average temp. for period.	Maximum temp. for day.
5.30–9.30 a.m......	55·5	10·9	12·0	9·6	12·0	66·2	
9.30–11.30 a.m.....	36·6	1·4	28·3	0·0	33·7	85·0	
11.30–1.30 p.m.....	26·6	0·2	31·5	0·8	40·9	90·8	
1.30–3.30 p.m......	44·7	0·4	25·8	1·2	27·9	91·0	93° F.
3.30–8.00 p.m......	79·0	10·1	3·2	4·3	3·4	80·2	
FOR WHOLE DAY.	54·7	6·5	16·1	4·4	18·3	—	
FOR WHOLE DAY.	54·7	22·7		22·6			

Date: 31.12.40.—*Group:* Lucerne Pasturage.

Period.	Grazing.	Standing. In Sun.	Standing. In Shade.	Lying. In Sun.	Lying. In Shade.	Average temp. for period.	Maximum temp. for day.
6.0–9.30 a.m.......	59·9	12·2	5·3	18·7	3·9	59·0	
9.30–11.30 a.m.....	44·2	7·1	12·9	1·7	34·1	71·2	
11.30–1.30 p.m.....	39·9	3·2	21·0	4·2	31·7	78·2	86° F.
1.30–3.30 p.m......	48·6	2·9	14·1	8·3	26·1	83·5	
3.30–8.00 p.m......	87·5	2·2	6·4	0·7	3·2	81·4	
FOR WHOLE DAY.	60·2	6·5	10·3	7·5	15·5	—	
FOR WHOLE DAY.	60·2	16·8		23·0			

Date: 20.11.40.—*Group:* Lucerne Pasturage.

Period.	Grazing.	Standing. In Sun.	Standing. In Shade.	Lying. In Sun.	Lying. In Shade.	Average temp. for period.	Maximum temp. for day.
6.00–9.30 a.m......	52·0	13·3	8·0	16·0	10·7	66·5	
9.30–11.30 a.m.....	29·7	8·3	27·1	0·5	34·4	72·8	
11.30–1.30 p.m.....	65·1	4·7	14·1	0·5	15·6	79·0	
1.30–3.30 p.m......	64·1	9·4	1·6	5·2	19·7	81·9	82° F.
3.30–6.00 p.m......	86·7	5·0	0·8	5·4	2·1	78·8	
FOR WHOLE DAY.	59·6	8·7	9·6	6·9	15·2	—	
FOR WHOLE DAY.	59·6	18·3		22·1			

The following part of the experiments cover the effect of absence of shade on the growth of fat lambs:—

C. Effect of Absence of Shade on the Growth of Fat Lambs.

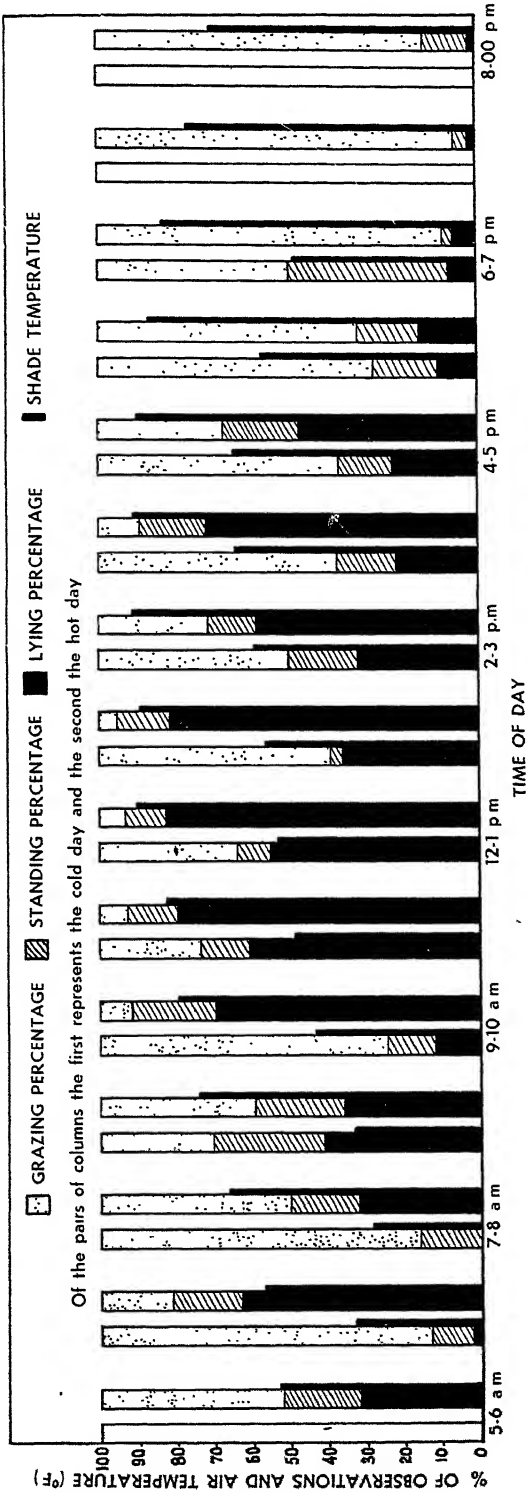
The technique of this experiment amounted briefly to a comparison of the growth of two equal groups of fat lambs. They received identical treatment except that one group was provided with shade of which free use could be made, whereas the other group had no access to shade. Lucerne grazing was used. The experiment period covered the whole summer, beginning on 3rd November 1942, and ending on 6th May, 1943, when grazing activities had to be discontinued owing to frost.

The ewes used were Dorset Horn, Border Leicester and Romney Marsh-Merino cross ewes, with Southdown triangular cross lambs and Merino ewes with Border Leicester and Romney Marsh cross lambs. At the beginning of the experiment on 3rd November, 1942, the ages of the lambs ranged from 3 to 13 days and they were divided at random into two groups of 15 ewes and 15 lambs each.

It was determined by statistical analysis that there was no significant difference in body weight between the two groups of ewes or lambs.

GRAPH III: GRAZING HABITS OF SHEEP

COMPARISONS BETWEEN A COLD AND A HOT DAY



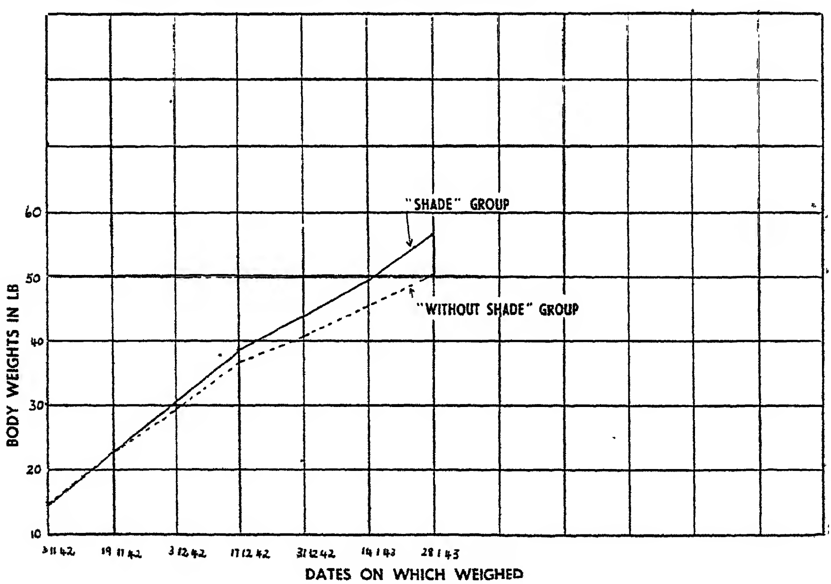
Body weights were taken every 14 days after a starvation period of 14 to 18 hours, and at every weighing the ewes and lambs were dosed against internal parasites. A salt-bonemeal-sulphur lick was always provided. Clean drinking water from a tap was provided in troughs. The weights of the lambs were statistically analysed every 14 days and the first date on which a statistical difference was determined was on 28th January, 1943. A summary of this analysis is given in table III.

TABLE III.—*Summary of Analysis.*

Variation.	Degrees of freedom.	Sum of squares.	Average of squares.	Value of F.	Significance.
Between groups.......	1	347·9	347·9	—	For $n_1 = 1$ and $n_2 = 28$
Fault......	28	1120·6	40·02	8·69	$P = 7{\cdot}64$ at 0·1.

The average weights of the "shade" group and the "without shade" group was 56·37 and 50·7 lb., respectively.

GRAPH IV GROWTH CURVES OF LAMBS



Since several lambs were ready for slaughter at this stage, slaughtering was commenced and the growth curves of the two groups is represented in graph IV up to this date only.

From the above it can be concluded therefore, that the absence of shade impaired the growth of lambs to a significant extent.

The experiment was continued however, and lambs weighing from 55 lb. were slaughtered, whereas on the first and second slaughtering dates only lambs with a body weight of 60 lb. and over were slaughtered.

Slaughtering was carried out on 25th February, 1943, and on 25th March, 1943, and lambs which had not attained slaughtering

weight by 6th May, 1943, were not slaughtered. A summary of the slaughtering data is given in table IV:—

TABLE IV.—*Summary of Slaughtering Data.*

Group.	Number in group.	Number Slaughtered on			Number not slaughtered.	Average body weight of lambs slaughtered.	Average of lambs slaughtered.	Average carcase weight.	Grading.			
		28 1.43	25.2.43	25.3.43					A.	B.	C.	U.
						lb.	Days.	lb.	%	%	%	%
Shade..	15	5	3	3	4	62·5	114·7	29·3	36·4	45·5	9·1	9·1
Without shade..	15	1	—	4	10	57·7	135 6	27·3	60	40	—	—

It can be seen from the above data that the "shade" group surpassed the "without shade" group in respect of the following, viz.:—

(1) The number of lambs slaughtered early in the season and throughout the season. The lambs grow more rapidly and fewer lambs unfit for slaughter remained in the "shade" group.

(2) The slaughtering weight. The "shade" group attained a higher weight than the group without shade.

(3) The slaughtering age and the carcase weight. The "shade" group was slaughtered at a younger age than the group without shade and had a higher carcase weight.

The group without shade was superior to the "shade" group in respect of grading only. Fewer lambs were slaughtered in this group, however, and better grading results were obtained since only the best of the group were slaughetered.

The above experiment therefore demonstrated the necessity for the regular provision of shade to crossbred lambs as a protection against the hot summer sun; since this precaution will ensure healthier lambs, capable of utilizing their feed more effectively. Absence of shade probably results in the utilization of more energy for cooling the body which may reduce milk production of the ewes. The quantity of milk produced is, however, not the only important factor; its comparison is no less important. Kelly and Rupel[12] found that milk production was about the average in cows kept at a stable temperature of 60-65° F., but that the butterfat percentage was below normal. Fluctuations in both the quantity and composition of the milk will inevitably reduce the rate of growth of the young animal.

In view of the above experiments provision is always made at the Grootfontein College of Agriculture, for shade for ewes and lambs. Secondly, an experiment was also carried out in which lambing ewes were allowed to graze on irrigated pastures for part of the day only, viz., for an hour in the morning and for an hour in the afternoon. For the rest of the day they were fed on veld grazing or lucerne hay in hay racks under trees. Considerable savings are effected throughout in the limited available pastures (results available in Reprint No. 63 of 1944 from "Farming in South Africa"). For the rest. effective use is made of the available fooder.

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Fodder Racks for Sheep:—

[*Continued from page* 155.

wall and collect in the crib. The fodder rack is constructed against a wall or otherwise two rows may be built back to back as shown in Figure 6.

(4) *Hay rack for feeding sheep in times of drought.*—This hay rack is quick to construct. A rack, 100 ft. in length, capable of feeding 200 sheep simultaneously, can be constructed within two days by two workmen. The construction costs are very low. The droppers are 3 ft. long and are attached at intervals of 4 inches to two lengths of No. 8 wire strained double. Lengths of sheet iron of 2ft. 6 in. are placed in the inside, sloping down on either side to where they touch the droppers. They are secured at the top with binding wire.

At intervals of ten feet on the rack the opposite walls are braced first, by supporting two droppers immediately opposite each other above and below with two crosspieces and then with two bracing wires strained crosswise from the top of the one to the bottom of the other. To prevent wastage of the leafy portion, 6 ft. wooden posts sawn through, are placed on their sides on the ground on either side of the fodder rack and pegged down. These form a kind of a crib and contribute to an amazing extent towards preventing wastage.

Drinking-water and Salt Lick.

The provision of fresh, clean drinking-water is, of course, no less important than the feeding of the sheep. Where necessary, a cement crib may be built for the purpose at a low cost. The crib should project about 1 ft. above ground level. The walls of the crib may be 3 in. thick. An outlet pipe should be built in at one end of the crib to let out the water when the crib is cleaned.

Where sheep are fed over a long period, especially grassveld areas, it is essential that they should receive a bonemeal-salt lick. A mixture consisting of two parts of bonemeal and one part of salt fed at the rate of one ounce per sheep per day, will furnish the mineral requirements of the sheep.

The Horse on the Farm.

X. Common Diseases of Horses in South Africa.

Dr. P. J. v.d. H. Schreuder and F. B. Wright, Senior Professional Officers (Horses.)

IT is manifestly impossible within the compass of this short article to deal adequately with all the diseases affecting horses in South Africa. The following notes will therefore be confined to the principal causes of losses in South Africa and include only the recognized methods of treatment.

Horse-sickness.—This disease is prevalent over the greater part of South Africa. It is commonest in the lowveld of the Transvaal and Natal, and less common in the southern and western portion of the sub-continent and on the high plateau of central South Africa. In the lowveld areas it occurs every year; in the other regions named sporadic cases occur in most years, but in certain years heavy losses may also be suffered.

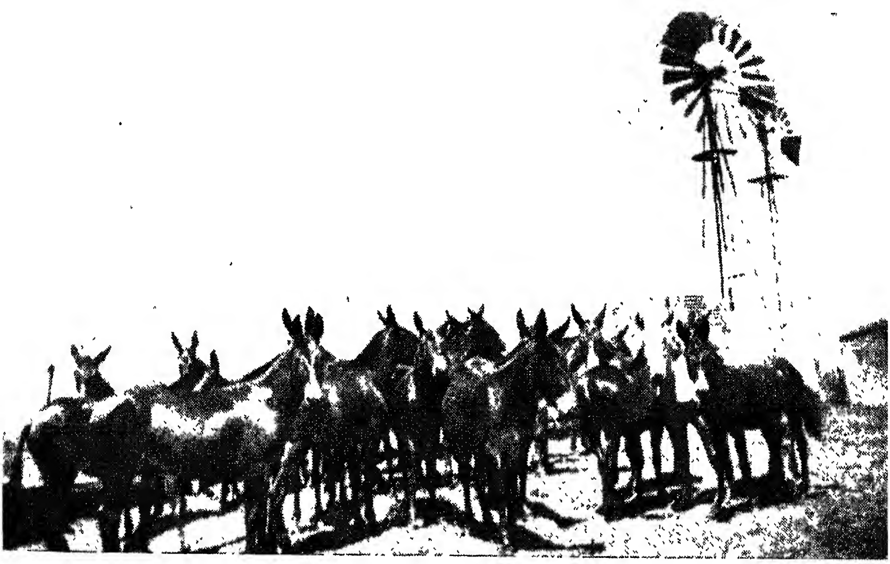

FIG. 1.—Mules bred from grade Percheron mares.

The disease commonly makes its appearance in late summer and increases in severity until the first good frosts, when it ceases abruptly. This phenomenon is directly related to the life history of the vector—a midge—which thrives in the summer and autumn. The actual infectious organism is an ultravisible virus carried by the midge. Two forms of the disease are commonly recognized, namely, (*a*) the more severe or dunkop form, which is characterized by a rapid accumulation of fluid in the lungs and early death, accompanied by the discharge of large quantities of froth from the nostrils, and (*b*) the commoner and less severe dikkop form which is characterized by swellings about the head—most commonly above the eyes, but the whole face may at times be swollen and the swelling may extend down the neck.

There is always a temperature with horse-sickness, but the animals continue feeding almost to the end.

Recovery occasionally occurs, generally from the dikkop form, and the animal is then immune to the particular strain of virus with which it was infected. If moved to an area where a more virulent strain exists, the animal may succumb to that strain of virus in some subsequent season.

In treating infected animals it is essential that they should be separated from other animals, kept under cover and left in complete quietude. The diet should be cut down to the barest minimum during the course of the disease.

Horse-sickness has lost much of its former significance since the Division of Veterinary Services produced an efficient vaccine against this disease some twelve years ago. The vaccine costs 5s. a dose and is obtainable, with full directions regarding its use, from the Director of Veterinary Services, Onderstepoort, during the period 1 June to 15 December each year. The vaccine is fairly delicate and susceptible to excessive heat, so that it is advisable to get inoculations done during the cooler portion of the year, and to use the vaccine immediately on receipt and not on the last day of its given period of efficiency.

Anthrax.—This is a very fatal disease of many animals, including man. In South Africa it is met with most commonly in cattle and sheep, but horses are also susceptible. In these animals it is most commonly met with in the western Transvaal, western Orange Free State, and adjacent parts of the Cape Province due to the presence of the biting fly, *Hippobosca*, which through its close and constant association with horses, serves to spread the disease from one animal in a troop to another.

Anthrax may take a peracute form where an apparently healthy animal suddenly becomes distressed and soon falls to the ground in convulsions, death rapidly supervening. The subacute form is more common. Here there is a rise in temperature, the appetite is lost and swellings appear on the lower portions of the abdomen, the limbs and between the thighs below the tail. The animal may live for two or three days. Recovery does not occur. After death a bloody discharge from the nostrils and anus is often seen. The spleen is generally very much enlarged.

On farms where anthrax is known to exist, any sudden death must always be treated with suspicion. The carcases of suspected cases should never be opened because the comparatively easily killed anthrax bacillus forms very resistant spores in the presence of oxygen, thereby perpetuating the infection. A blood smear obtained from a small cut in the ear of the carcase should be made and forwarded to the nearest Government Veterinary Officer for examination.

Anthrax is so rapidly fatal that it is not often that a chance for treatment presents itself. Neoarsphenamine is an efficient curative but its administration is complicated and best done by a veterinary surgeon. Penicillin is also claimed to be effective, the dose for a horse being 6,000,000 (six million) units daily.

The Division of Veterinary Services manufactures an efficient anthrax vaccine, which is sold at 3d. for ten doses.

Biliary Fever.—This is an infectious disease of horses and is caused by one of two parasites of the red blood cells, *Nutallia equi* or *Babesia caballi.* The disease is transmitted by the redlegged tick, *Rhipicephalus evertsi*, and consequently the disease is most

prevalent where this tick abounds, namely in the low lying, subtropical portions of the country. The highveld is largly, but not entirely free.

The first symptom is a rise in temperature, which may pass unnoticed until the owner realizes from its sluggishness and partial or complete loss of appetite that the animal is ill. When this stage is reached an examination of the conjunctiva (the membrane lining the eyelids) will show it to have lost its normal pink colour and to have become yellow or yellowish brown in appearance. One or more large blood spots may also be present. This yellow colour is characteristic of the disease, and where it occurs combined with a high temperature, biliary fever may invariably be diagnosed. An orange-coloured conjunctiva is seen in Senecio poisoning, but there is no rise in temperature in this condition. Biliary fever is a very debilitating disease and the animal rapidly becomes weaker. When the animal is forced to move swaying of the hindquarters is common. Swellings of the legs are also often seen. The disease lasts from seven to twelve days and is generally, though not invariably, fatal unless treated. Imported horses show a much more severe reaction than colonial breds. Importers should therefore watch new arrivals carefully after arrival.

FIG. 2.—Well bred, well developed two year old Percheron fillies now in central stud at Grootfontein College of Agriculture.

There are various proprietary and subcutaneous injections that are very efficient in the treatment of biliary fever, provided the treatment is commenced sufficiently early, but they are often ineffective if treatment is left until the disease is well advanced. The names of such proprietary preparations may be obtained from any veterinary surgeon. Where biliary fever is prevalent, it is advisable to keep one or two injections on hand.

Dourine.—This is a disease of horses that is confined chiefly to the southern and western portions of the Cape Province, western Orange Free State and western and north-western Transvaal. It is

caused by a trypansome, *Trypanosoma equiperdum*, and is transmitted from mare to stallion and *vice versa* at the time of copulation. Very occasionally it may be transmitted by biting flies. The disease runs a long course, from six months to two years. In the early stage swelling of the penis and sheath is seen in the stallion. Later these swellings extend along the abdomen and backwards between the thighs. In the mare the vulva and area below the vulva between the thighs becomes swollen, and later these swellings may extend to the udder and lower portions of the abdomen. The swellings are doughy and painless. There is frequently a discharge from the vulva, which may also show unpigmented spots on the skin. An irregular temperature may be noted. Later round, flat swellings may appear on the skin.

As the disease progresses, the animals become thin and weak, especially if on low diet or engaged in hard work. A weak and wobbling gait is frequently seen in the later stages. Later paralysis of various nerves sets in, e.g. the nerves supplying the face, ears and eyelids. The hind quarters frequently become paralysed and the animal is often unable to rise and eventually succumbs in a weak and emaciated state. There is no remedy for the disease.

Dourine is a notifiable disease under the Diseases of Stock Act.

Joint ill and Naval ill.—These are really one and the same disease. Symptoms may be confined to the joints or naval, or both may be involved. Different species of bacteria have been incriminated as causal agents and the virulence of the condition varies with the species of the responsible organism. Infection may take place through the freshly ruptured navel string or may occur in the womb of the dam.

Symptoms appear from 3 to 14 days after birth in virulent cases and in less virulent cases at any time up to six months after birth. The naval will be found to be swollen and hot, causing marked lameness of the foal. Pus may accumulate in a joint which eventually may burst. Death rapidly follows in most cases.

Good results may be obtained from the use of the sulpha drugs, e.g. sulphamerazine. An initial dose of ten half-gramme tablets is followed by half that dose twice daily for three or four days and then once a day for a further two days. Penicillin in oil or wax at the rate of 300,000 units per day also gives good results. The above doses are for very young foals. The results obtained may vary somewhat, depending on the type of invading bacteria.

Strangles.—Strangles is an acute infectious disease of horses characterized by inflammation of the mucous membrane with a purulent discharge from the nostrils, and swelling and abscess formation in the adjacent lymph glands. It is a particularly common disease where large numbers of horses are gathered together. The disease is very infectious and is spread by contact with, or ingestion of, the infected discharges.

The incubation period is from four to eight days. The affected animal shows an initial rise in temperature to 104-106° F. There is loss of appetite and a watery discharge from the nose. A cough may also be present, and the animal appears to be developing a cold. The watery discharge becomes purulent, and the horse may have difficulty in swallowing owing to the inflammation having spread to the throat. In the simplest form of strangles the lymph glands between the jaws swell and abscesses develop in them. In five or six days the abscess bursts and dicharges its contents, the temperature drops, and the animal begins to mend.

Unfortunately a more serious form of the disease may develop. The glands in the throat region may become involved. These generally burst into the throat and, although the pus often escapes via the nostrils, some of it may be drawn into the lungs and give rise to a fatal pneumonia. At other times abscess form within glands or organs contained in the chest or abdomen. These cases are invariably fatal. The disease runs its course in from two to four weeks.

In recent years the sulpha drugs have been largely employed in the treatment of strangles. The dose for an adult horse is three ozs. for the first dose, followed by half that quantity twice a day for three or four days. The authors cannot, however, claim to have seen good results in strangles from the use of the sulpha drugs, or from the use of penicillin. When the discharge from the nose is excessive, considerable relief may be given the patient by steaming with Friar's Balsam or Oil of Eucalyptus. Sawdust or dry grass is put in the bottom of a bucket. About a dessert spoonful of Friar's Balsam or Oil of Eucalyptus is added, and a pint of boiling water is then poured into the bucket. This is held about a foot below the horse's head so that it may inhale the vapour that arises.

FIG. 3.—A troop of grade Percheron mares. City Council, Pretoria.

As strangles is a very infectious disease, rigid isolation of infected horses, their utensils and, where possible, their attendants should be practised.

Mange.—Mange is a disease of the skin caused by a very small mite, *Sarcoptes scabei* var. *equie*, which burrows into the skin. Where horses are in poor condition, as in the case of unfed horses running on the veld in winter, the disease spreads rapidly and may cause the death of the animal. The affected portions of the skin become hard, cracked and scurfy, and the hair falls out. The mite causes considerable itching so that infected horses constantly rub the affected parts of the skin against any convenient object such as a post or tree, very often infesting these objects with mite, which may find a new host

in some fresh horse using the same objects as a scratching post. Saddlery and grooming equipment that have been used on infested horses also serve as intermediate agents for the spread of infestation. The mite cannot live for long off its host, so that premises that have housed mange infested horses may be rendered quite safe by closing them to horses for a period of three weeks.

It is not difficult to cure a horse of mange, provided the job is tackled thoroughly. The two commonest curative agents are:—

1. A mixture of 1 lb. sulphur, 1 pint paraffin, one gallon used motor oil or 8 lb. lard.

2. Lime-sulphur dip. (Any good proprietary brand which will have all the directions for mixing.)

Either of these agents is scrubbed into the skin over the entire body. It is advisable to cut off the mane to facilitate penetration. The essential thing is to break down all scabs with a scrubbing brush. This process, repeated three times at intervals of not less than eight days and not more than ten days, will effect a cure.

Ringworm and Allied Fungus Diseases.—The symptoms vary somewhat according to the type of fungus infecting the skin. The lesions may be in the form of typical rings, or they may start as small raised nodules in the skin, the tops of which break away leaving a moist area which soon dries out and becomes scurfy and spreads rapidly in an irregular manner. Where the disease does not cause much formation of scurf and the hair is comparatively short, the application of strong tincture of iodine is effective. Another useful remedy is a mixture of 2½ per cent. salicylic acid and 2½ per cent. benzoic acid in liquid paraffin. In the other type of ringworm mentioned, washing the entire body twice with 1 per cent. of certain proprietary disinfectant at an interval of a week between washings is very effective. A brush should be used to ensure thorough penetration of the disinfectant to the skin. As ringworm is very infectious, grooming kit used on infected horses should also be disinfected by soaking for several hours in a 1 per cent. solution disinfectant. (The names of suitable disinfectants can be obtained from veterinary officers.)

Internal Parasites.—Worm infestation is a serious problem in horses. It is particularly so in areas of high rainfall during the summer months because humidity and warmth are necessary factors in the development of the eggs. Worm infestation is responsible for much unthriftiness in adult horses. Its effects are even worse in foals and yearlings whose growth may be seriously retarded by a severe infestation.

The following are the internal parasites that do most damage and which are most commonly met with:—

(1) *Ascarids.* These are long white worms up to eight inches in length, which inhabit the small intestine.

(2) *Strongyles*, of which there are various species. These are small worms inhabiting the large intestine.

(3) *Bots*, which inhabit the stomach.

(4) *Pinworms*, which inhabit the large intestine and caecum. The fertilized females migrate to the rectum and lay their eggs round the outside of the anus, where they may be seen in whitish clusters.

There are excellent remedies for most worms, but they are not all easily administered by the layman. Bots and Ascarids may be treated with carbon bisulphide. The dose is 2½ c.c. per hundred pounds live weight. The effect may be increased by adding a similar

amount of tetrachlorethylene to the dose. These drugs are best administered by means of a stomach tube. Where this is not available, they may be given as a drench in a pint of liquid paraffin for an adult horse. The animal must be starved for twenty four hours prior to drenching. The most effective drug against strongyles is phenothiazine. The dose is 2½ grammes per hundred lb. live weight. This is a powder and is readily taken in the feed by horses. If the horse to be dosed is very thin and weak, it is safer to divide the dose roughly into five equal parts and give one part every day for five successive days. This is also advisable if the horse to be dosed will not take the large single dose in its feed. No starvation or other preparation is necessary prior to or after the administration of this drug, except that the animals should be given no fast work for three weeks.

Phenothiazine also combats the pinworms in the large intestine and caecum. The worms in the rectum may be removed by enemas of luke warm water and salt—2 to 3 lb. of salt to four gallons of water.

Colic.—This is a much misunderstood term among laymen, most of whom regard it as a specific disease, which can be cured by a "colic drench"—generally raw linseed oil and turpentine. In reality colic is a term employed to indicate a set of symptoms that are fairly constant in character and indicative of abdominal pain, generally as a result of some derangement of the alimentary tract. The commonest symptoms are pawing, sweating, turning the head to the flank, crouching and rolling. These of themselves give no indication as to where the trouble lies. It may be a stomach or large bowel packed with food, or a twist of the large or small bowel. In

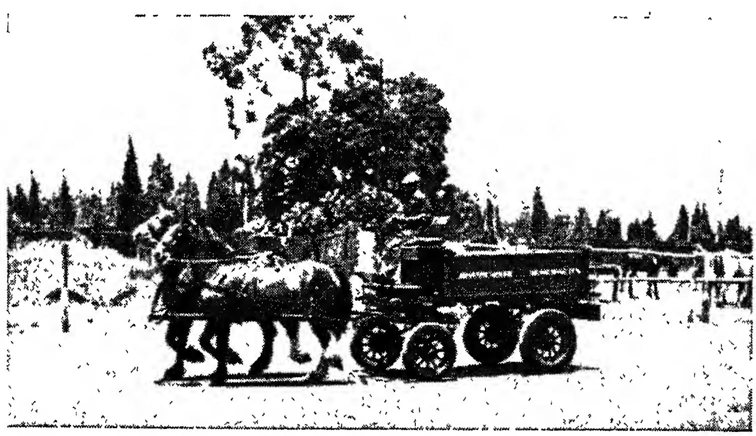

FIG. 4.—A Clydesdale team. City Council, Johannesburg.

flatulent colic the diagnosis is comparatively easy. Treatment by the layman is therefore very much of the "hit and miss" variety. When one has a valuable horse, however, and no professional assistance is available, one is justified in doing what one can for the animal.

For flatulent colic a subcutaneous injection of 1½ grains arecoleine hydrobromide (for a full-grown horse of about 1,000 lb. weight) dissolved in 5 c.c. of water is the most useful drug. The drug is a powerful purgative and will sweep the gases and fermenting food out of the bowel. It causes a good deal of distress to the animal, but in such a crisis drastic measures are necessary. One of the symptoms

produced by this drug is profuse salivation. Its action is rapid and may be expected to take place within five to ten minutes of administration.

For colic caused by constipation a most useful drug is dihydroxyanthraquinone. This drug is sold under different trade names, which can be obtained from a veterinary surgeon. It is in the form of a powder and can be given in the food in varying amounts. The directions supplied by the makers of the particular brand used should be followed in its administration.

Any sort of twisted of strangulated bowel will prove fatal.

Laminitis. This is an inflammation of the horn-secreting tissue inside the hoof. Common causes are:—

(1) Too long standing, e.g. during long rail or sea journeys.

(2) Over-feeding on heating foods such as maize, especially when insufficient exercise is given.

(3) Travelling at high speed on excessively hard surfaces.

(4) Drinking of large quantities of cold water when hot.

In mares the condition also often follows septic inflammation of the womb, e.g. after a retained afterbirth, abortion or difficult foaling.

One or more feet may be affected; generally both fore feet are affected. When this is the case, the animal thrusts both fore feet well forward so that the weight is taken on the heels. At the same time the hind legs are drawn well under the body to take a greater share of the bodyweight than usual off the fore feet. If the hind feet are affected, the fore feet are placed well under the body and the hind feet advanced to take as much weight as possible on the heels The condition is an exceedingly painful one.

Treatment consists of cutting down all grain and giving only hay and green feed. A rapidly acting purgative such as a subcutaneous injection of 1-1½ grains of arecoleine hydrobromide in 5 c.c. water should be administered. A hose should be turned onto the feet for several hours a day, or better still, the horse should be stood in a stream if one is available and the animal can walk there. At night the feet should be packed in clay. Horses that have once had laminitis are liable to contract it again, so that this particular idiosyncrasy should be guarded against.

Tetanus.—This is a disease which is sometimes met with in horses. Is is caused through the tetanus bacillus, which is a normal inhabitant of many soils, gaining entrance to the body, generally through an earth-contaminated wound. Very often the wound is in the foot, having been caused by some penetrating object such as a nail. The disease is characterized by spasms of the muscles. The head is thrust forward stiffly on the neck, while the muscles of the shoulder, back and croup are rigid. The third eyelid is drawn across the eye. The tail may be rigidly extended. Any sudden stimulus such as a noise or the action of opening the stable door may throw the muscles into a state of spasm. Recovery is uncommon. Infected animals should be confined in a dark stable away from all noise and left strictly alone.

The chief thing to remember about this disease is that it can be prevented by thorough cleaning of all wounds and by the administration of anti-tetanic serum immediately after the wound has been caused.

Pasture Control.

With Special Reference to the Border Area.

J. H. Preller, Pasture-Research Officer, College of Agriculture, Potchefstroom.

PASTURE maintenance and improvement should go hand in hand with improved systems of animal feeding for of what avail is to have fat animals in summer, only to lose them in winter because of inadequate feeds?

If an area is pre-eminently suitable for stock farming it does not follow that crop production cannot occupy any place in that area. On the contrary it is in these very areas that crop production should play an important part, in as much as fodder crops are a valuable means of supplementing the grazing when necessary, in order to ensure a

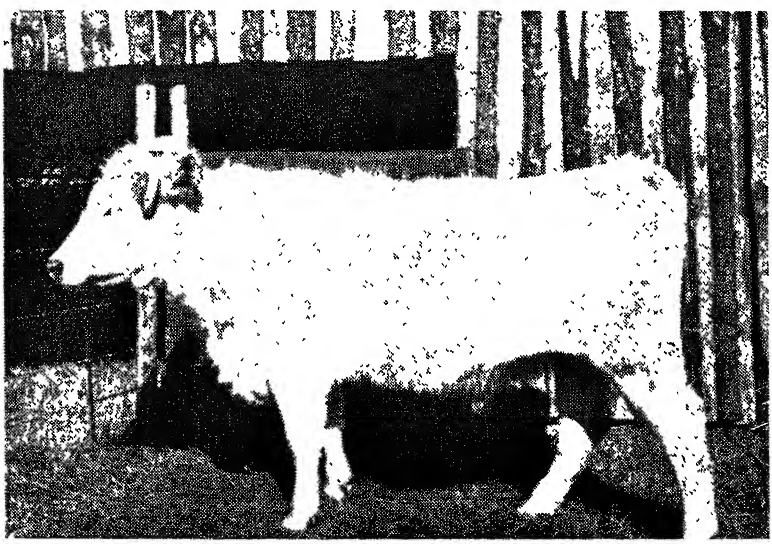

FIG. 1.—Ox fed on veld hay from veld fertilized with 400 lb. superphosphate and 400 lb. ammonium sulphate per morgen.

maintenance ration for the animals throughout the year. Stock farming can contribute considerably towards keeping the production capacity of the limited arable land on a high level.

Stock Farming in the Border Area.

Its soil and climatic conditions make the Border Area eminently suitable for stock farming, crop raising being important only for the production of supplementary feeds. It therefore behoves the stock farmer in this area to increase his knowledge of veld, in order to be in a position, not only to prevent retrogession but also to improve the veld.

This border area is bounded on the south by the railway line from Somerset East to East London, whence the boundary runs to Mortimer, Waverley, west of Sterkstroom to Lady Grey, Rhodes and Maclear, through Qumbu as far as the Umzimvubu River and thence to Port St. Johns.

This area can be subdivided on the basis of veld type into three main parts viz.: —

(i) The coastal belt with its dense vegetal cover, which furnishes excellent grazing both in summer and in winter.

(ii) The long-grass area with its preponderance of sour veld, which if well controlled can provide excellent grazing in summer. In autumn, however, the nutritive value diminishes rapidly and consequently the veld is virtually useless in winter.

(iii) The short-grass sweet veld area where the grass retains much of its nutritive value and palatability throughout the year and where camps can be spared during the summer months for winter; this is not the case in the sour veld.

Although these veld types differ widely, the main points of control, viz. camping off, rotational grazing, watering and the relation between sheep and cattle, remain essentially the same.

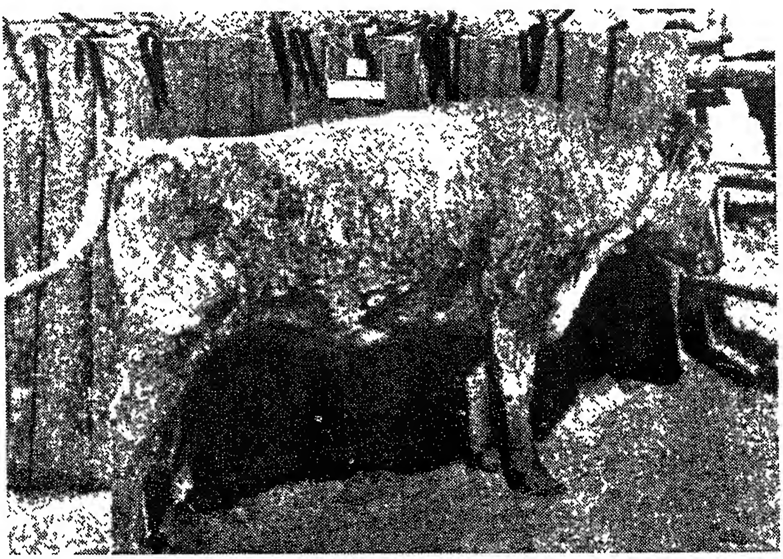

FIG. 2.—Ox fed on veld hay (veld unfertilized) and silage.

The results referred to in this article were obtained in experiments carried out at the Döhne experiment station over a period of five years. This experiment station is situated in the long-grass sour veld area, five miles north-east from Stutterheim and about 50 miles from the coast. These experiments are discussed in greater detail in Science Bulletin No. 280 of 1947 (which will appear shortly).

Malpractices with Veld Control.

In the past veld utilization in this area consisted mainly in allowing cattle and sheep to graze *ad lib.* with the result that the most palatable grasses were selected first and overgrazing ensued. Owing to the absence of proper camp systems and good veld control, the less palatable grasses became hard and unpalatable and in order to dispose of these, veld burning was repeatedly resorted to.

This wasteful method of veld utilization not only causes big annual losses of valuable animal feeds but also a gradual deterioration of the

veld, since the best grasses never have an opportunity of running to seed, whereas the less desirable grasses have ample opportunity.

A further outcome of this practice was that undesirable and even poisonous plants such as thorn trees (*Acacia* spp), "dwagha" (*Senecio retrorsus*), "Harpuisbos" (*Europs floribundus*), "ouhout" (*Leucosidea sericea*) and "grysbossie" (*Cluytia alaternoides*) increased to such an extent in some areas as to render stock farming well-nigh impossible.

FIG. 3.—Veld grazed by 12 sheep per morgen.

The fact that injudicious sheep farming continues, especially in the long-grass sour veld area, has aggravated the above menaces to no small extent. It is known that sheep cannot thrive on long-grass veld, least of all on long-grass sour veld and consequently the veld *must* be kept short for them. In order to achieve this, the veld is burnt at any time and then severely grazed. Such a practice can only lead to rapid deterioration of the veld, for no veld can stand this type of treatment indefinitely.

Since, judging from the condition of the animals, this system of burning and severe grazing proved successful at first, it became a general practice and one which farmers found impossible to relinquish owing to the farming system applied. With increase in undesirable grasses and plants, farmers are later forced to burn against their will. The result is an acceleration of the tempo of veld retrogression.

Effect of Veld-Control Systems on the Animal.

That animals show different reactions to different systems of veld control is clearly evidenced by table 1 which shows the average increase in the weight of animals per morgen per season over a period of five seasons* in experiments 2, 3, 5 and 6 and four seasons in experiments 8 and 9.

TABLE I.—*Average increase in weight per morgen per season for five seasons.*

Experiment :	2	3	5	6	8	9
	lb.	lb.	lb.	lb.	lb.	lb.
Total increase in weight from season 1939–40 to 1944–45............	652	1,075	826	881	758	534
Total increase per weight per morgen	489	948	551	587	505	356
Average increase in weight per morgen per season..................	98	190	110	117	126	89

KEY TO TREATMENTS.

Experiment 2.—Rotational grazing with three head of cattle on eight camps of half a morgen each.

Experiment 3.—Rotational grazing as under Experiment 2 with an annual application of 400 lb. superphosphate and 200 lb. ammonium-sulphate per morgen.

Experiment 5.—Continuous grazing from the earliest possible date in spring with two head of cattle to three morgen. Alternate halves are burnt during winter.

Experiment 6.—Continuous grazing from the earliest possible date in spring with two head of cattle to three morgen. The whole camp is burnt every winter.

Experiment 8.—Continuous grazing from the earliest possible date in spring with two head of cattle to three morgen. The whole camp is cut down in winter

Experiment 9.—Continuous grazing from the earliest possible date in spring with two head of cattle to three morgen. As soon as selective grazing is evidenced, one-third of the camp is cut down and after that further thirds, as required.

* It should be pointed out that in the case of experiments 2, 3, 5 and 6 for the period 1939-40 to 1944-45 weights for only five and not six seasons are available since the scale was damaged by fire in 1942-43. For the same reason weights for experiments 8 and 9 are available for four seasons only.

As a result of fertilizer applications, it was possible in the case of experiment 3 to increase the carrying capacity from 1941-42 from 3 to 4 head of cattle.

From Table 1 it is evident that rotational grazing plus fertilization gives the highest weight increase per morgen. The question is, however, whether it will ever be economical to fertilize this type of sour veld and whether it would not be better to use the fertilizer on high-producing crops and high-quality artificial pastures. The latter would seem to be the most economical system.

Experiment 8 showed the second highest increase in weight, while experiments 5 and 6 also showed higher weight increases than experiment 2. It should be noted, however, that in experiments 5, 6, 8 and 9 there were clear signs of veld deterioration. This is not the case in experiment 2. It must therefore be assumed that this bigger weight increase as compared with experiment 2, was obtained at the expense of the veld.

Experiments with Sheep.

In regard to sheep, it appears from table 2 that where there is no subdivision of the veld, as in the case of experiments 1S, 2S and 3S, and where the carrying capacity differs, there is only a small average seasonal increase in weight of 6·6 lb. for the group as a whole, in experiment 1S, whereas in the case of experiments 2S and 3S there is actually a decrease in weight of 4·0 and 13·8 lb., respectively. The sheep therefore actually weighed less at the end of the season than at the beginning.

According to these data a carrying capacity of six sheep per morgen seems to be too low and one of 12 sheep per morgen, too high. The extent of damage to the veld when grazed by sheep only will, however, be pointed out later.

In the case of experiments 4S, 5S and 7S where subdivision was practised and a system of rotational grazing followed, with the same carrying capacity in each case, the average seasonal increase per group was 29·8, 35·8 and 28·5 lb., respectively.

These weights must be compared in particular with those of experiments 1S, since the carrying capacity in all the cases was eight sheep per morgen.

A comparison between the weight increases in experiments 4S, 5S and 7S reveals the highest weight increase in experiment 5S, where annual burning was carried out. As in the case of cattle, it may be said that this favourable weight increase was, without a doubt, obtained at the expense of the veld. As will be shown later, this veld has been severely damaged.

It is evident, therefore, that subdivision does result in a considerable weight increase in the animals.

This in no wise means, however, that subdivision offers a solution where only sheep farming is applied under these conditions, since judging from the weight increases, it is clear that the system is far from satisfactory.

TABLE II.—*Total weight increases per morgen of sheep under different systems of veld control.*

Season.	1S. lb.	2S. lb.	3S. lb.	4S. lb.	5S. lb.	7S. lb.
1939–40........	—17	—15	not begun.	not begun.	not begun.	not begun.
1940–41........	35	—15	8	not begun.	not begun.	not begun.
1941–42........	60	5	15	95	60	80
1942–43........	—5	10	10	25	35	35
1943–44........	—40	—20	—100	—35	20	—20
1944–45........	Ended	11	—2	34	28	19
TOTAL.........	33	—24	—69	119	143	114
Average per season.....	6·6	—4·0	—13·8	29.8	35·8	28·5

KEY TO TREATMENTS.

Experiment 1S.—Continuous grazing from the earliest possible date in spring with eight sheep to 1 morgen. Burning, if necessary.

Experiment 2S.—Continuous grazing from the earliest possible date in spring with six sheep to 1 morgen. Burning, if necessary

Experiment 3S.—Continuous grazing from the earliest possible date in spring with twelve sheep to 1 morgen. Burning, if necessary.

Experiment 4S.—Rotational grazing with eight sheep to one morgen according to the four-camp system. Cut down in winter, if necessary.

Experiment 5S.—Rotational grazing with eight sheep to one morgen according to the four-camp system. Burnt every winter.

Experiment 7S.—Rotational grazing with eight sheep to one morgen according to the four-camp system. Burnt one winter and cut down the next winter.

N.B.—According to the four-camp system, a camp is grazed for a week by sheep and rested for 3 weeks.

Where grazing was carried out with cattle and sheep in rotation as in experiment 7 where two head of cattle were followed by eight sheep in a system of five camps, one of which was closed during the summer to allow the grass to run to seed, the sheep by no means had the detrimental effect on the veld as was the case where the veld was grazed by sheep only.

In this case too, the sheep actually showed the highest increase in weight, viz. an average of 45·6 lb. per season over a period of five seasons.

It would appear, therefore, that a ratio of four or even three sheep per head of cattle would be best.

For further particulars in this connection, see Science Bulletin No. 280 of 1947.

Effect of Grazing Systems on the Veld.

If weight increases in animals were our only aim (and in so many cases it actually is the only aim), the solution to the problems of veld control would be simple, but since in a sound veld control system the welfare of both the animals and the veld is aimed at, the problems of veld control are much more complicated.

Hence, it would be interesting to study the reaction of the veld under summer-grazing experiments with cattle only, with sheep only, and with cattle followed by sheep.

Where a system of rotational grazing was applied, as in experiments 2 and 3 with sheep or experiment 7 where cattle were followed by sheep, no signs of damage to the veld were observed. On the contrary, the veld showed denser and more uniform growth, with a definite decrease in the occurrence of *Senecio retrorsus* (dwagha), a very poisonous plant sometimes responsible for heavy stock losses.

In experiments 5 and 6 where burning was carried out and there was no subdivision, there were very definite signs of damage to the veld as is evidenced by the multiplication of *Senecio retrorsus, Elyonurus argenteus* (lemon grass), the larger bare patches between plants and the drying off of many plants.

Where there was no subdivision, but where it was endeavoured to control the veld by moving, as in experiments 8 and 9, there were also signs of veld deterioration as is evidenced by the increase of *Elyonurus argenteus, Helichrysum* spp. (sewejaartjies) and *Gnaphalium* spp. (vaalbossies).

Here damage is caused by the fact that in spite of the use of the mowing machine, cattle still graze selectively and then continue to concentrate on patches, leaving the less palatable grasses to mature and run to seed.

If grazing is carried out with sheep only, the veld is damaged in either case, irrespective of the system followed. The least deterioration, however, takes place under a system of rotational grazing with four camps where the veld is cut down every winter in order to remove surplus old grass and so enable the sheep to begin their grazing on uniformly short veld in spring. This system is not always practicable since, owing to the uneven surface and the labour required, it is not always possible to cut down all the veld.

Where the veld is burnt one year and cut the next, the damage is less severe than with annual burning, which is the most general practice. The former method, however, brings with it the problem of cutting the veld down in winter.

Where annual burning is carried out, whether or not subdivision is applied, the veld is severely damaged, as is evidenced by the marked increase in *Senecio retrorsus, Senecio pteropherus* (which overruns the veld in cases of extreme damage only), *Elyonurus argenteus, Cassia mimosoides* (a worthless perennial legume), the drying off of established grasses and the complete disappearance of dead vegetable matter from the soil surface.

Effect of Autumn Burning.

As soon as the nutritive value of the veld begins to decrease and the sheep no longer make any progress, some other provision should be made for them until such time as the winter crops are suitable for grazing. Here the general practice is to burn a piece of veld in February and then run the sheep on the young burnt veld during April-May

That the carrying capacity of the veld is exceptionally low, is shown by the fact that from such burnt veld where 2½ morgen were grazed by 20 sheep during the autumn of 1945 and 1946 only 560 and 336 sheep days, respectively, were obtained per morgen. During 1945 the veld could be grazed for ten weeks and during 1946 for six weeks. During 1945 the sheep were purposely kept on the veld for a long period to see how rapidly their weight would decrease. During the first six weeks they gained 70 lb. in weight altogether, whereas during the next four weeks they lost 116 lb.; i.e., they were then 45 lb. below the initial weight. During 1946 the increase during the first two weeks was 47 lb., but during the following four weeks there was a weight decrease of 60 lb., bringing their weight to 13 lb. below the initial weight.

FIG. 4.—Veld grazed by eight sheep per morgen—continuous grazing.

As a result of the disturbance of plants by autumn burning they tend to run to seed without showing much leaf growth—hence the low carrying capacity. Plants which in particular run to seed, during this time include the inferior *Tristachya hispida* (rooisaadgras) *Alloteropsis semialata* (Blackseed grass) and *Senecio retrorsus*.

It is clear that this treatment cannot but have a detrimental effect on the veld.

In order to bridge the autumn period, use may be made of the aftermath of perennial cultivated summer grasses or perennial winter pastures.

Effect of Winter Grazing Systems on the Animal.

Since the natural veld is virtually useless during winter and the animals make practically no use of it after the frost, we cannot speak of winter grazing on the natural veld in the true sense of the word.

It is, however, important to determine to what extent veld-grass hay can serve as a stock ration during winter.

Although good veld-grass hay is readily eaten by cattle, sheep hardly eat it at all. They wander about the veld, looking for the negligible quantities of half green blackseed grass, which are inadequate for keeping them alive, with the result that they lose condition to such an extent that death would ensue if they were not removed.

According to experiments where the cattle received only veld-grass hay during winter and were allowed to run freely in their grazing camp, the animals showed an average weight decrease of 1·3 lb. per week over a period of four months where the veld was fertilized and 3·5 lb. where no fertilizer was applied. The period during which the cattle had to be fed averaged 17 weeks, i.e. they showed an average weight decrease of 22 lb. and 59 lb., respectively on hay from fertilized and unfertilized veld. This decrease in weight is negligible if compared with conditions generally found on farms where cattle must exist on the veld only, without any hay. In such cases the animals lose hundreds of pounds in weight and in long winters deaths from emaciation frequently reach a very high figure.

It would seem that the best practice in winter would be to feed all dry cattle on veld-grass hay in sheltered kraals thereby ensuring protection against the cold and eliminating trampling of the veld and loss of condition. At the same time favourable conditions are created for making valuable compost.

Taking into account, further, that about one ton of veld-grass hay is obtained from a morgen, that from 1 to 1½ tons of hay are required per animal for the winter and that the cutting of hay facilitates veld control and limits veld burning and all its concomitant evils, it is clear that veld-grass hay should play an important rôle in the general farming systems.

Where sheep had to subsist during winter on the veld on veld-grass hay, there was a rapid decrease in weight. Despite the fact that in addition, 1 lb. of babala silage was fed per animal per day the group of eight sheep showed a weight decrease of 25, 17, 60 and 52 lb. during 1940-41, 1941-42, 1942-43 and 1944-45, respectively. It is patent that sheep cannot be kept on this type of veld during winter. Provision must be made for additional supplementary feed in winter, in the form of green grazing, silage and tubers such as turnips or mangold.

Supplementary Feed for Winter.

From the foregoing it should be clear, that in this area it is not possible to keep cattle and sheep on the veld during winter without considerable weight losses and even mortalities as a result of emaciation. Thus, the only expedient is to make provision for winter feed.

Mention has already been made of the value and possibilities of veld-grass hay, but in view of the low yield per morgen and the somewhat low nutritive value of this hay, it cannot be regarded as sufficient.

Since the possibilities for irrigation for green winter pasturage are limited in this area, the most obvious time for making fodder is the summer, when farmers can avail themselves of the rainfall and apply the dryland system.

It is also possible in that season to make practically unlimited quantities of hay from crops such as teff and Japanese millet, Rhodes grass, the millet seed grasses or setaria and *Acroceras macrum*. Silage

can be made from babala and maize and also from perennial grasses such as Napier Fodder and Setarias. In addition, mangold and turnips may be cultivated in summer for use during winter.

From 5 to 7 tons of hay may be expected from these hay crops and this hay is of a considerably higher quality and also more palatable than veld-grass hay. From 25 to 40 tons of silage material per morgen may be expected from babala or Napier Fodder and Setarias.

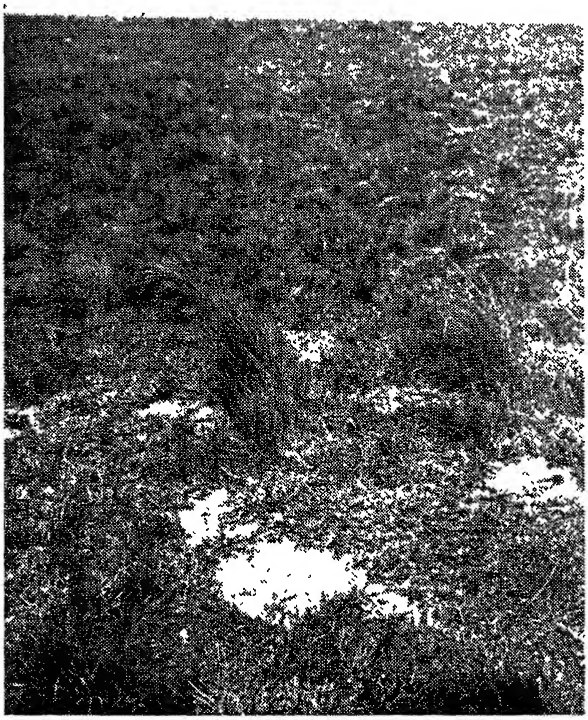

FIG. 5.—Veld grazed by six sheep per morgen.

In order to show the value of a few of these fodders, it may be pointed out that on Rhodes grass only, cattle gained one lb. per week in weight and on Rhodes-grass hay and 25 lb. of babala silage per day and *Acroceras macrum* hay and 25 lb. of babala silage per day, they showed a weight increase of 6 and 10 lb. per week, respectivelv.

Summary.

(1) With a proper camp system this type of sourveld can be successfully controlled with cattle in summer.

(2) It is impossible to control this type of veld with sheep only.

(3) With a proper camp system and a ratio of 3 to 4 sheep per head of cattle, the sheep can play a rôle in these farming systems without much danger of damage to the veld.

(4) Veld-grass hay ought to play an important part on every farm and should be supplemented further with hay and silage of annual and perennial grasses and crops.

Fertilisers for 1948.

FARMERS are notified that during 1948 all fertilisers will be supplied subject to permits issued by the Fertiliser Controller, c/o Division of Chemical Services, Private Bag, Union Buildings, Pretoria.

A misunderstanding has been created by a statement in the Press last year that the fertiliser supply position has improved so much that probably no permits will be necessary in 1948. The correct version is that probably no permits will be necessary *from the end of* 1948. Although this correction was widely published it would seem that many readers missed it. Consequently, some farmers are under the impression that they need not take their permits seriously as there will be no difficulty in obtaining their fertiliser requirements.

The issue of permits to all applicants who submitted returns prior to 31 October 1947 has just been completed. Persons who have not received their permits to date should therefore communicate with the Controller immediately so that the Post Office can be asked to endeavour to trace them, failing which duplicates can be issued. Applications received after the above date will be disposed of during the next few weeks.

Emphasis must again be laid on the fact that permits which are not submitted to the fertiliser traders for recording *within two months* of the date of issue are no longer valid. Such permits can be restored partially (in exceptional cases fully) only if the supply position at the time permits. The old excuse that the permit could not be submitted because the holder did not have the necessary cash at the time is worthless, for the permit form states clearly that arrangements with the suppliers about orders can be made later.

Farmers must again be warned that exceptional difficulties are experienced every year in the case of fertiliser orders for the period July-October. The demand for fertilisers in those months is so colossal that the manufacture, packing and loading cannot keep pace with the orders. On top of that the demands made on the Railways during that period for the transport of maize and other commodities are so great that they cannot release a sufficient number of additional trucks to cope fully wih the fertiliser trade. Farmers will therefore act wisely if they place their orders and accept delivery as early as possible. All fertiliser factories are authorised to commence with the execution of orders for the second and third quarters as soon as they have disposed of the first quarter's commitments. The person who places his order early and arranges payment for early delivery will therefore not run the risk of being without fertiliser when he has to plant.

(Controller of Fertiliser.)

Milk-Testing Course at Glen.

A milk-testing course of three weeks' duration will be held at the Glen College of Agriculture *from* 1 *to* 18 *June* 1948.

The course is open to candidates who have passed the standard 8 (Junior Certificate) Examination or its equivalent. Preference will be given to candidates with higher academic qualifications and to those who wish to be appointed to the milk-recording staff of the Department of Agriculture, as vacancies arise. Fees, including boarding, £4. 10s. 0d.: plus 10s. deposit. Apply to the Principal, Glen College of Agriculture O.F.S. for full particulars.

Genetic Aspects Associated with the Propagation of Citrus.

J. D. J. Hofmeyr and P. C. J. Oberholzer, Agricultural Research Institute, Pretoria.

PERENNIAL horticural plants are propagated preferably by vegetative methods, e.g. by means of bulbs, roots, tubers, cuttings, or by budding and grafting. These methods are well known for their economic advantages, but it is nevertheless desirable to emphasize briefly certain breeding aspects. By means of inbreeding, annual plants will breed true from seed within a relatively short time, while in the case of most perennials, this will not be obtained within an ordinary lifetime.

According to the established principles of heredity, assortment and recombination of genetic factors or genes take place only during the sexual process, i.e. with seed formation. This process is eliminated with vegetative propagation, and hence the new individual is genetically identical to the parent plant. Strictly speaking, it is incorrect to speak of a new individual in this case, since it is actually the parent tissue that continues to grow unchanged. Apart from mutation, crossing and selection constitute the experimental method designed to develop new varieties, which are then perpetuated by means of vegetative propagation.

With fruit trees, budding and grafting are the common methods employed in propagation. The rootstock employed for this purpose may be related to the scion variety, or even be of a different species. Generally speaking, seedling trees are more vigorous and attain greater age as compared with budded or grafted ones, so that the bud-union is apparently the weak link in the life of such trees. Since the rootstock is generally raised from seed, considerable variation must be expected as a result of hereditary differences. Such variation can be minimized by raising rootstocks vegetatively(4), or by utilizing nucellar embryony in the case of most citrus fruits.

Vegetative propagation is inducive to the accumulation of degeneration diseases, a fact not generally appreciated by most horticulturists. In the present article emphasis will be placed particularly on this aspect of breeding.

Degeneration and Vegetative Propagation.

Senility.—Some 200 years ago it was observed that potato yields declined with continued cultivation, necessitating the use of new seed potatoes or tubers for sustained production. It was believed that this decline was due to senile decay, a process which is favoured by vegetative propagation. In 1913, however, Herbert Nilsson(6) published the results of an experiment comprising 67 potato-varieties, which indicated that Hvit Jambtländis-potatis was the highest yielder, despite the fact that it was already under cultivation for over 100 years in Sweden. According to Winkler(9) the banana has been propagated vegetatively for thousands of years without any significant decline in vigour. These and other similar examples prove that senility offers no explanation for the phenomenon of degeneration.

Virus Infection.—It is now generally accepted that the decline of potato varieties is due to the accumulation of degenerative diseases—especially virus diseases—which is favoured by vegetative propagation. Since aphids act as vectors in this case, no degeneration ensues if plants are kept free from such insects. These observations also apply to other plants which are susceptible to virus infection.

Although the virus is of systemic nature, i.e. invades all vegetative tissues, like tubers, bulbs, roots and shoots, the seed generally remains free from infection, a fact which is made use of in obtaining a virus-free progeny.

General Aspects Concerning Virus Diseases.

It is obviously impossible to present here a detailed discussion concerning the characteristics of the virus. Attention is therefore directed mainly to a few aspects that have a bearing on the subject under discussion.

Plants differ in their reactions to virus infection. Thus a plant may be completely resistant, so that a particular virus cannot exist within it. Again, immunity may be attained through the presence of avirulent strains of the virus, which, although causing no visible deleterious effects, might act in a protective capacity against infection by related virulent strains of the same virus. Tolerance against a virus favours the continued existence of the particular plant, but at the same time acts as a source of infection for other plants not possessing such tolerance. As an illustration [(1) p. 16] may be mentioned the potato varieties Majestic and Up-to-date which are tolerant of virus X, while Epicure, Arran Crest and King Edward are disastrously affected by it. A plant might attain protection through utmost intolerance, e.g. *(a)* by necrosis or death of cells of the infected tissue, so that this restriction of the virus prevents its spread to other parts of the plant; (b) total and rapid destruction of the entire plant, thereby eliminating the source of infection.

Environmental factors, especially light and temperature, might influence the expression of symptoms caused by the virus. Thus the occurrence of the Phony Peach virus(5) in certain areas of the United States of America and its absence in others, is apparently related to differences in temperature. Psorosis and related diseases of citrus [(2) p. 824] may be present in a latent form for long periods of time. For further examples the reader is referred to the extensive literature on this subject.

Nucellar Embryony.

The seed of most species of citrus differs from that of most other fruit trees in one important respect, viz. in the occurrence of poli-embryony, or the development of more than one embryo within the same seed. One of these embrios is of sexual origin, i.e. results from the fusion of male and female gametes, while the others develop from the nucellar tissue surrounding the embryo-sac [(2) p. 789]. The vegetative origin of such embrios ensures that the resultant seedlings are genetically identical to the parent plant, and hence resemble the progeny obtained by budding or grafting, although certain non-hereditary differences in growth usually occur. Thus the nucellar seedling is generally more thorny than the parent tree, although this tendency gradually disappears with age of tree. Its greater vigour results in more vegatative growth, and hence lower fruit production. This difference in vigour in favour of the nucellar seedling is apparently due largely to the straining out of virus diseases [(2) p. 831]. The elimination of the virus responsible for incompatibility between the sour-orange rootstock and sweet-orange scion, and which is

present in old clones, by taking buds from nucellar seedlings([7]) indicates that virus diseases might be responsible for a large reduction in vigour and growth of citrus trees.

Nucellar embryony, like vegetative propagation, favours the accumulation of recessive mutations which may, however, be eliminated by sexual processes of propagation, especially if associated with inbreeding. This statement is verified by the fact that seedlings of the Shaddock (*C. maxima*l, where no nucellar embryony occurs, are more uniform and vigorous as compared with sexual variants of citrus species that exhibit nucellar embroyony [([2]) p. 885]. As a rule, the sexual variant is weaker as compared to the nucellar seedling, and also exhibits other differences which simplify identification. If, on the other hand, the object should be to obtain vigourous sexual variants by crossing, then obviously it would be no easy task to identify these seedlings as such.

Hereditary Variation in Citrus.

Both inbreeding and crossing, followed by inbreeding, are the recognised methods used by the plant breeder to obtain variant forms from which selections may be made. In other words, use is made of mutations which have accumulated during thousands of years and which, by crossing, are brought together into the desired combinations. In general, the object is to maintain the desirable characteristics of an old and established variety, and to improve it by crossing with a variety possessing the missing characters. It stands to reason that the task of the plant breeder to obtain the desired combination is greatly complicated as a result of the accumulation of undesirable mutations due to nucellar embryony and vegetative propagation, especially when closely related plants are crossed [([2]) p. 891]. Outstanding seedlings are readily obtained by species-crossing [([2]) p. 892], but this offers no solution to the problem under discussion, i.e. the improvement of existing clones. When the object is, therefore, to add only one (or a few) desirable character to the existing complement, this can be accomplished by means of bud-variation.

Bud variation originates from a single cell, which had undergone mutation in its preceding ontogeny. Hence, bud variation in its initial stages must constitute a chimera-condition with the parent tissue. (A chimera is a plant, or part thereof, consisting of two or more types of tissue of different genetic constitution). As a result of unequal rates of growth, it is possible for one type of tissue to replace completely the others in certain sectors, and hence be perpetuated in pure form by means of budding. Generally speaking, however, separation of tissues does not take place readily, a fact which constitutes one of the most trying problems as regards the selection of bud variants for propagational purposes. Thus experience has indicated [([2]) p. 883] that some good varieties were originally rather unstable, possibly on account of a chimera condition of the original variant. Unless the object is to perpetuate these variations by propagation, it would be unsafe to take budwood from such parent trees, even though all the buds be taken from an apparently normal sector. Since the nucellar embryo originally develops from a single cell, nucellar seedlings could be used to propagate variant tissue in pure form, provided of course that it embraces the area from which the seed develops.

Bud variation occurs quite commonly in citrus varieties. Thus Shamel reports the following: in a Navel orchard [([2]) p. 921], 24 per cent. of trees varied to such an extent as to necessitate topworking, while 25 per cent. was found in a Valencia grove [([2]) p. 931]. In a Marsh-grapefruit orchard comprising 500 trees, 123 were found to bear fruit

containing 30 to 90 seeds per fruit [(2) p. 941]. (The Marsh is a seedless variety). These data are concerned with easily discernible characters, and hence it is quite possible that variation might occur with an even greater frequency, since it is known that mutations causing slight variation are much more common as compared to those responsible for larger variations.

Discussion.

It seems desirable to stress a few important aspects in relation to citrus breeding, especially as regards the problem of virus diseases:—

1. Vegetative propagation favours the accumulation of virus diseases, which may result in degeneration.

2. Virus diseases might be present in certain plants without causing visible symptoms, but might be lethal to others not possessing tolerance; the former may therefore act as source of infection of the latter.

3. Virusses are of systemic nature, generally penetrating all vegetative tissue, but the seed is usually not infected.

4. Nucellar embryony sustains the genetic composition of the parent tree in the resulting progeny.

5. The sexual progeny seldom equals or excells the parent tree, and hence offers only limited possibilities as regards selection.

6. The high frequency of bud variation constitutes a promising source for the improvement of existing varieties.

The decrease in vigour caused by the presence of virus diseases is related to the degree of tolerance possessed by the particular plant. This may vary from extreme intolerance, in which case the plant is rapidly destroyed soon after infection, to great tolerance, where the virus apparently does not impede growth. It is, however, an open question whether in the latter case, the plant is not deleteriously affected in some way or other. Frost [(2) p. 831] expresses the opinion that the greater vigour of trees propagated from nucellar seedlings, as compared with those from an old clone, may be related to the straining out of virus diseases. According to this worker, it might be desirable, in the case of the Satsuma mandarin and Eureka lemon, to resort periodically to budwood of nucellar origin, in order to maintain the desired degree of vigour.

If immunity in a certain clone be obtained by the presence of avirulent strains of the virus, then the elimination thereof will leave the plant unprotected and a new prone to infection. Certain virus diseases are apparently transmitted only by budding, in which case the use of nucellar budwood would be advantageous, and perhaps even desirable. Vigour apparently also bears some relation as regards resistance against insect pests and plant diseases, an observation which merits further study with the object of reducing costs of production.

Uniformity of plant material is of the utmost importance in trials where differential treatments like methods of fertilization, irrigation, etc., are being studied. Even with the selection of good parent trees, the resulting progeny still exhibit considerable variation, indicating possible inherent differences. The older such trees become, the greater the number of cell generations separating budwood taken from different sectors, and hence the greater the possibility for bud variations. Chimera-tissue occurring unobserved in the parent tree may thus appear in an accentuated degree in the resulting progeny. Since initially only one type of tissue is present in the nucellar embryo, this source of variation is to a certain extent eliminated, resulting generally in less variation.

Although suffering from certain disadvantages, nucellar material nevertheless possesses advantages. In fact it would appear as if the prejudice against the use of such material is perhaps not altogether justified, and experiments are being planned to study this matter in greater detail.

It seems desirable to mention here the large amount of inferior plant material at present supplied for commercial planting, and to stress the urgent necessity of devoting the necessary attention to this matter. The genetic composition of the plant is apparently regarded as of minor importance, and the solution of problems is sought in a possible lack of soil fertility, nutrition, etc. These two aspects viz. the genetic composition of the plant on the one hand, and its environment on the other, constitute the corner stones of the entire fruit industry; both are equally important in the future maintenance of the industry. It would appear that some of our most serious problems, e.g. " stem pitting " of grapefruit, could have been largely eliminated if timely attention was devoted to the particular plant material. A detailed investigation regarding the source of plant material used for propagation purposes can result only in benefit to, and greater stability of, the fruit industry.

Some Serious Citrus Problems.

In conclusion, brief reference in respect of the foregoing discussion will be made to a few serious problems encountered with citrus in South Africa, and to which a considerable amount of research work has already been devoted:—

1. *Incompatibility Reactions.*—Since the earliest times of citrus culture in South Africa it has been known that certain stock-scion combinations between various species of citrus were incompatible, i.e. fail to give normal growth. The classical example is undoubtedly the failure of sweet orange (*C. sinensis*), naartjie (*C. reticulata*) and grapefruit (*C. paradisi*) when budded to the sour-orange (*C. aurantium*) rootstock. By utilizing the phenomenon of nucellar embryony, previously referred to in this article, Oberholzer(7) has shown that a virus is the underlying cause. Fortunately this problem holds, at present, no practical implications to the citrus industry of South Africa, since the rootstock used, viz. the rough lemon, is apparantly resistant to this virus. The Argentine and Brazil were less fortunate in this respect, since in these countries some 8 million sweet-orange trees on sour-orange rootstock have been completely destroyed up to the present by the so called " Tristeza " disease. As far as is known, this destruction work is continuing unabatedly. At present a desperate struggle is also being waged against the so called " Quick Decline " disease in California. Both " Tristeza " and " Quick Decline " are apparently related to the problem of incompatibility under discussion. It would appear that any sweet-orange tree on sour-orange rootstock may become the prey of the dreaded virus, and if it is borne in mind that several milions of trees of this particular stock-scion combination are to be found in other parts of the United States of America, Spain, Palestine, etc., then one gains some conception of the extreme gravity of this particular problem.

2. *" Stem Pitting " of Grapefruit.*—As a result of research work conducted by the Citrus Research Station at Addo(3), it has been established that the extensive decline of grapefruit trees in South Africa (popularly referred to as " stem pitting ") is probably caused by a virus, apparently of the psorosis-type. According to information supplied by this institution, approximately 40 per cent. of all commercial grapefruit trees are so severely affected as to render them practically worthless, which gives some indication of the extent and importance of this problem.

Important data have been assembled which may well hold a solution to this serious problem, although admittedly further research work is required.

3. *"Greening" Problem.*—The so called "greening" problem has been known for some twenty years, and is of great importance, especially in citrus regions of the Transvaal Lowveld. It occurs largely amongst sweet-oranges (especially the Valencia) and naartjies, causing restricted tree growth, associated with small malformed (so called "greened") fruits. An enormous amount of research work has been devoted to this problem, but as yet no progress has been made in this respect. The writers are at present engaged in a detailed investigation of this problem, especially with reference to specific aspects emphasized in this article. Although no definite results have thus far been obtained, the writers are of the opinion that some or other virus might also be connected with this problem. The fact that "greening" is found to occur also on trees grown in complete nutrient solutions is a strong indication in this direction.

Selection Procedure.

As mentioned before, bud variation offers greater scope for the improvement of existing clones, as compared with crossing under the particular conditions. Furthermore, it would appear as if all bud variations are originally of a chimera nature, and hence the problem is how to separate the different types of tissue in order to obtain a progeny of pure form. Mutations of long standing, i.e. of many previous cell generations, might, as a result of unequal growth, have the variant tissue in pure form in certain sectors, or perhaps even the entire tree. Separation can also be accomplished very efficiently by the advent of nucellar embryony, provided of course that the variant tissue occurs in the region from which the seed develops.

It is possible that all hereditary factors or genes originated at some time or other as a result of mutation, since new mutations stil occur with a relatively high frequency. It is an established fact that plants show genetic differences in relation to disease resistance. In the case of the incompatibility phenomenon previously referred to, definite differences as regards resistance to the causal virus have been established between various species of citrus. In cases where other virus diseases are suspected e.g. "stem pitting" of grapefruit, there are likewise definite differences as regards resistance. Thus the Marsh Seedless is apparently much more susceptible than Triumph, whereas the sweet orange is even more resistant. The same phenomenon is also experienced with "greening", where certain species are apparently not susceptible.

The usual procedure in selection for resistance would be to search for trees occurring in heavily affected orchards, but which are devoid of the symptoms of the particular disease. Such trees might, however, as a result of possible escape of infection, not possess actual resistance towards the disease. The opposite procedure would be to focus attention primarily on diseased trees, with the object of obtaining bud variations that have acquired resistance. As far as the authors are aware, this method of selection has, thus far, not been purposely adopted, and yet it merits consideration. The following discussion will throw further light on the subject.

In view of its systemic nature, the virus penetrates all vegetative organs of the plant. Should variant sectors, free from the particular symptoms, develop from such a diseased medium, this must be an indication that resistance has been acquired. Absence of disease symptoms from such sectors may be due to actual resistance or tolerance against the existing virus. Viewed in the light of the previous discussion, caution will be necessary as far as the application of nucellar embryony in breeding

problems are concerned. The co-operation of citrus growers and others in the search of trees in affected orchards, or limbs of diseased trees that are free from the particular symptoms would be of great value in relation to breeding problems concerning "stem pitting" of grapefruit and "greening" of sweet oranges and naartjies. Such trees or limbs could be labelled, and brought to the attention of the authors for closer study. It is even desirable to search for other bud variants that may prove to be of economic importance, e.g. seedlessness in certain varieties, etc.

Note.—The purpose of this article is to direct attention to breeding aspects associated with the propagation of fruit trees, a matter which apparently does not receive the desired attention. Certain aspects of the discussion have as yet not been sufficiently verified by experimentation, but may be stimulative in the approach towards the particular problems. It is hoped that the matters discussed in this article will receive the earnest attention of the South African Nuserymen's Association which was formed at Bloemfontein at the end of 1947.

Summary.

1. Emphasis is placed on the dangers of the accumulation of certain degenerative diseases, like virus diseases, as a result of vegetative methods of propagation.

2. Nucellar embryony may be employed in order to purify plant material from virusses, without sacrificing its genetic constitution.

3. The greater vigour of plant material of nucellar origin is probably largely due to the elimination of virus diseases.

4. Crossing offers only limited possibilities as a method of improving citrus varieties.

5. Bud variation occurs with a high frequency, and may possibly be used advantageously for improving existing clones.

6. The chimera condition of variant tissue presents difficulties in propagating bud variants in pure form. Lack of conformity between variant sectors and the progeny may be due to a chimera condition.

7. Under certain conditions, nucellar embryony might be employed as a purifying process in order to separate tissues of different genetic constitution.

8. Despite certain unfavourable characteristics, nucellar plant material possesses certain advantages. The future use of such material therefore merits further investigation.

9. The three citriculture problems mentioned in this article appear to be related:—

(*a*) Incompatibility between certain species of citrus and the sour-orange rootstock is caused by a virus.

(*b*) There is strong indication that "stem pitting" of grapefruit may also be caused by a virus, probably related to psorosis.

(*c*) A tentative hypothesis is advanced, viz. that a virus is associated with the "greening disease" of sweet-orange and naartjie.

10. Although the incompatibility problem is at present of no practical importance in South Africa, "stem pitting" and "greening" are of great economic importance.

11. The co-operation of citrus growers and others is invited in the search for resistant material, as well as bud variants that might prove to be of importance in breeding work.

12. Bud variants occurring on virus-infected plants, but which are free from the disease symptoms, may be an indication that resistance has been acquired by means of mutation.

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IMPORTANT NOTICE.

Will persons who place orders for vaccines please note that:—

(*a*) No refund of the purchase price or credit will be made if purchasers return the vaccine to the Department.

(*b*) Such returned vaccine will always be destroyed.

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Short Courses at Glen College of Agriculture.

The following short courses will be held at the Glen College of Agriculture during 1948:—

Course.	Duration.	Class and Boarding Fees.
		£ s. d.
Three-weeks Course in Milk-testing, for intending Milkrecorders	1 June–18 June 1948.	4 10 0
Four-weeks Course in Grain Grading	22 June–16 July 1948.	6 0 0
Two-weeks Course in Poultry Farming	6 July–16 July 1948.	3 0 0
One-week Course for the Judging of Afrikander Cattle	Date to be announced later	1 10 0

Prospectuses for each of these courses are obtainable, and for further details, prospective candidates are requested to write direct to the Principal, College of Agriculture, Glen, O.F.S.

Crops and Markets

A Statistical and Economic Review of South African Agriculture

by

The Division of Economics and Markets

Volume 27 March 1948 No. 307

CONTENTS

Price Review for January, 1948.*

Fruit.—The markets were fairly well supplied with apples, peaches, pears and grapes which were disposed of at satisfactory prices. Offerings of oranges, lemons and avocados were not sufficient to meet the particularly good demand. Large quantities of papaws, mangoes and pineapples were also offered.

Tomatoes.—Offerings of tomatoes decreased and high prices were realised for tomatoes of good quality.

Potatoes.—Larger quantities of potatoes, particularly highveld potatoes, reached the markets and price reductions took effect. For example, on the Johannesburg market the prices of Transvaal potatoes, Grade I, decreased from 26s. 4d. per bag in December 1947 to 20s. 1d. per bag in January 1948. Natal potatoes, Grade I, on the Durban market from 32s. to 27s. 4d. per bag and Transvaal potatoes on the Pretoria market from 23s. 9d. to 18s. 7d. per bag.

Onions.—Larger consignments of Cape and Transvaal onions reached the markets. The quality was generally poor and lower prices were realised.

Vegetables.—The markets were still well supplied with most kinds of vegetables and prices were low.

Seeds, Grains and Feedstuffs.—Beans, peas and kaffircorn were offered in moderate quantities.

Feedstuffs.—Low prices were realised by large consignments of lucerne hay which were of poor quality. Small quantities of teff were disposed of at maximum prices.

Eggs and Poultry.—The supply of eggs was small on the Johannesburg market. Fowls were plentiful and were disposed of at satisfactory prices. Turkeys were, however, scarce.

* All prices mentioned are averages.

The Marketing of Wheat in Canada.

A REVIEW of the present world grain position was given in the previous issue of "Crops and Markets". In this article a brief description is given of the marketing of wheat in Canada.

In 1935 the Canadian Wheat Board Act was passed and a three-man board established to stabilise the price of wheat by offering a fixed price to producers. Formerly the method of stabilising was through purchases on the futures market.

But the creation of the Wheat Board in 1935 did not interfere with futures trading on the Winnipeg Grain Exchange. It was not until September 1943 that it became necessary to close the Winnipeg futures market and to place full control of the marketing of the Canadian Wheat crop in the hands of the Wheat Board. An initial price 1·25 dollar per bushel for No. 1 Northern basis Fort William, Port Arthur or Vancouver was fixed which remained in effect until July 1946, when a new wheat policy in respect of western producers and domestic and export prices was announced.

The new policy is based upon an initial price of 1·35 dollar per bushel basis No. 1 Northern in store Fort William, Port Arthur or Vancouver and applicable to all wheat delivered to the Canadian Wheat Board in the five-year period from August 1945 to July 1950, while the 1945-46 deliveries, based on the initial price of 1·25 dollar, will be brought to the 1·35 dollar basis by the payment of 10 cents per bushel on all grades. Supplementary payments above the initial 1·25 dollar was also made in respect of the 1943 and 1944 crops.

After the payment of ten cents per bushel on the 1945 crop has been made it is the intention to place all surplus receipts above the initial fixed price of 1·35 dollar per bushel from that crop in a five-year pool with the succeeding four crops of 1946, 1947, 1948 and 1949. Supplementary payments to growers will, however, not be made until after the conclusion of the five-years' pool at 31 July 1950.

The domestic price, e.g. for wheat used locally will remain at 1·25 dollar per bushel and the price of wheat for domestic use to millers at 77⅜ cents per bushel, the difference being subsidised by the Government. In February 1947 the domestic price of wheat was, however, advanced to 1·55 dollar per bushel.

In regard to the export prices, a four-year agreement was consumated in July 1946 between Canada and the United Kingdom. Under this agreement Canada will sell to the U.K. during that period a total of 600 million bushels of wheat. During each of the first two years 160 million bushels will be provided at a fixed price of 1·55 dollar per bushel basis ex-store Fort William, Port Arthur, Vancouver or Churchill. During each of the last two years the U.K. will accept 140 million bushels of wheat at a price not less than 1·25 dollar per bushel in 1948-49 and not less than 1 dollar in 1949-50 on the same basis. The actual prices to be paid during the latter two seasons will be decided on not later than the 31st of December immediately preceding the crop year for which it is effective. The agreement is subject to any modification becoming necessary to make it conform with any international agreement to which both countries may later become parties. The contract price under this agreement for the 1948-49 season has already been fixed at 2 dollars per bushel.

The fixed prices under this agreement have of course up to now been appreciably below the open-market prices.

In sales to non-contract countries, efforts will be made to sell at prices roughly corresponding to those ruling on the United States open market. Previous to this, the Canadian Government directed the Canadian Wheat Board not to exceed a sales price of 1·55 dollar per bushel for No. 1 Northern in its export sales.

Index of Prices of Field Crops and Pastoral Products.

THIS index as shown elsewhere in this issue, increased from 230 for the previous month to 233 in January 1948. The most important changes occurred in the following groups:—

(*a*) " Hay " decreased from 148 to 136 owing to a decrease in the prices of lucerne and teff.

(*b*) " Other Field Crops " i.e. potatoes, onions, sweet potatoes and dry beans show a decrease from 266 to 239 as a result of a decrease in the prices of potatoes, onions and dry beans.

(*c*) " Pastoral Products " increased from 253 to 269 due to an increase in the prices of hides and wool.

(*d*) " Slaughter Stock " decreased from 217 to 212 as a result of the reduction in the seasonal price of slaughter cattle in controlled areas.

Agricultural Conditions in the Union during January, 1948.

Weather Conditions.—Good showers of rain occurred in nearly all the summer cereal areas. The prospects for young summer cereal crops were promising, but were dependent on favourable climatic conditions later in the season.

Crops.—Winter cereal crops have been harvested, but yields were not according to earlier prospects as a result of wet weather which caused damage during the reaping of the crop.

Stock and Pastures.—In general, the condition of stock and pastures was still satisfactory. More rain was, however, necessary to ensure sufficient growth before the winter. Lumpy skin disease and nagana still occurred.

Review of the 1946-47 Cotton Crop.

(Compiled by the Office of Cotton Grading P.O. Box 956, Durban.)

IN spite of climatic conditions being more favourable than for some years the crop was affected by drought shortly after planting time. Very wet conditions were experienced during January and February, causing considerable shedding, otherwise the crop would have been much larger. The standard of lint was very good. This was reflected in the grading as not a single bale of off-coloured cotton was produced.

Owing to the great demand of lint by South African industries, and the considerable advance in price, farmers are showing greater interest in cotton. For the season 1947-48 a much larger acreage has been put under cotton. Good rains at planting have given the crop an excellent start, and provided adverse weather conditions do not set in, it should be the largest reaped for a number of years. As per Ginners' returns the total crop for 1946-47 amounted to 445,140 lb. lint, or 919 running bales.

Compared with those of previous seasons the details are as follows:—

	1946–47.	1945–46.	1944–45.	1943–44.	1942–43.
Running Bales...	919	274	293	525	472
Statistical Bales (500 lb.).......	890	272	270	530	467
Lint (lb.)........	445,140	136,115	135,087	264,989	233,439
Seed Cotton (lb.).	1,438,606	406,969	405,790	768,035	699,334
Seed (delinted and undelinted (lb.)	950,309	258,646	230,154	429,142	425,295
Linters (lb.)......	28,772	23,604	22,598	40,515	31,948

Production in different areas, with the last two seasons' figures for comparison, is as follows:—

	SEED COTTON (lb.)		
	1946–47.	1945–46.	1944–45.
Natal and Zululand.........................	129,742	—	36,149
Rustenburg area (including Pretoria and Marico)	—	1,624	12,947
Northern Transvaal (including Waterberg Pietersburg and Zoutpansberg)............	17,203	—	—
Eastern Transvaal (including Middelburg, Lydenburg and Barberton).....................	1,275,152	395,285	354,762
Cape Province...........................	2,512	—	1,932
Swaziland................................	13,997	6,450	—

Grading.

Comparison of Staple.	1946–47.		1945–46.		1944–45.		1943–44.	
	Bales.	Per cent.	Bales.	Per cent.	Bales.	Per cent.	Bales.	Per cent.
$1\frac{1}{4}$ inch and above.....	—	—	—	—	3	1·02	—	—
$1/^{3}_{16}$th inch..	2	0·22	—	—	—	—	2	0·38
Full $1\frac{1}{8}$ inch..	174	18·93	6	2·19	—	—	—	—
Good $1\frac{1}{8}$ inch	702	76·39	195	71·17	277	94·54	476	90·67
$1\frac{1}{8}$ inch......	41	4·46	73	26·64	13	4·44	47	8·95
$1^{1}/_{16}$th inch and below.	—	—	—	—	—	—	—	—
TOTAL...	919	100	274	100	293	100	525	100

Comparison of Grades of Good Colour Cotton.

	1946–47.		1945–46.		1944–45.		1943–44.	
	Bales.	Per cent.	Bales.	Per cent.	Bales.	Per cent.	Bales.	Per cent.
"Middling fair"......	—	—	—	—	—	—	—	—
,, Strict good middling".	207	22·52	46	16·79	90	30·72	8	1·52
,, Good middling".....	301	32·75	116	42·34	91	31·06	191	36·39
,, Strict middling"......	358	38·96	96	35·04	89	30·37	240	45·71
,, Middling".	53	5·77	7	2·55	10	3·41	35	6·67
,, Strict low middling".	—	—	—	—	—	—	—	—
Good colour..	919	100	265	96·72	280	95·56	474	90·29
Fair colour..	—	—	—	—	—	—	—	—
Very light spotted....	—	—	9	3·28	1	0·34	42	8·00
Other off-colour......	—	—	—	—	12	4·10	9	1·71
TOTAL...	919	100	274	100	293	100	525	100

Index of Prices of Field Crops and Animal Products.

(Basic period 1936-37 to 1938-39=100.)

SEASON (1 July to 30 June).	Summer cereals. (a)	Winter cereals. (b)	Hay. (c)	Other field crops. (d)	Pastoral products. (e)	Dairy products. (f)	Slaughter stock. (g)	Poultry and poultry products. (h)	Combined index.
WEIGHTS.	19	13	2	3	34	6	17	6	100
1938–39.......	92	109	96	89	79	102	106	94	93
1939–40.......	86	114	77	95	115	105	106	89	104
1940–41.......	108	120	106	156	102	108	110	103	109
1941–42.......	120	144	143	203	102	131	135	136	124
1942–43.......	160	157	144	159	122	147	168	167	147
1943–44.......	170	186	137	212	122	154	185	188	159
1944–45.......	183	186	160	281	122	177	179	184	164
1945–46.......	201	194	164	312	118	198	185	170	170
1946–47.......	241	209	149	232	177	205	192	204	200
1947—									
January.......	242	210	144	174	188	194	200	238	205
February......	240	210	127	157	198	194	191	248	206
March.........	240	210	154	158	199	194	182	251	206
April..........	239	210	176	169	200	194	179	283	208
May............	225	210	166	187	203	194	183	318	210
June..........	225	210	169	213	183	247	186	291	206
July..........	224	210	184	216	184	261	191	207	203
August........	225	210	184	213	185	261	196	188	203
September.....	226	210	184	229	241	261	200	169	223
October.......	227	210	151	265	233	261	210	176	223
November.....	226	212	169	266	255	214	216	184	229
December......	226	212	148	268	253	214	217	210	230
1948—									
January.......	226	212	136	239	269	214	212	208	233

(a) Maize and kaffircorn.
(b) Wheat, oats and rye.
(c) Lucerne and teff hay.
(d) Potatoes, sweet potatoes, onions and dried beans.
(e) Wool, mohair, hides and skins.
(f) Butterfat, cheese milk and condensing milk.
(g) Cattle, sheep and pigs.
(h) Fowls, turkeys and eggs.

Average Prices of Green Beans, Green Peas and Carrots on Municipal Markets.

Season (1 July to 30 June.)	Green Beans (Pocket 20 lb.).			Green Peas (Pocket 20 lb.).			Carrots (Bag). (*a*)		
	Johannesburg.	Cape Town.	Durban.	Johannesburg.	Cape Town.	Durban.	Johannesburg.	Cape Town.	Durban
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1938–39	1 8	2 3	2 0	2 4	1 9	1 2	3 8	2 6	6 1
1940–41	1 11	2 9	1 5	2 8	2 4	2 3	5 9	4 11	13 4
1941–42	2 7	3 10	2 6	3 11	3 3	3 4	8 5	8 11	17 2
1942–43	3 1	4 3	3 0	3 3	2 10	3 9	5 1	8 9	13 2
1943–44	3 8	4 11	3 0	4 11	4 10	4 11	9 11	11 1	20 2
1944–45	3 7	5 1	4 1	4 9	4 1	5 5	8 3	9 11	19 10
1945–46	3 4	4 7	3 6	5 11	7 2	6 1	8 10	11 4	17 1
1946–47	3 11	3 7	3 6	4 10	4 3	5 0	5 9	4 9	14 11
1946—									
July	3 2	1 11	2 2	2 7	3 6	3 4	3 8	4 8	7 10
August	6 3	4 2	6 6	5 10	5 0	4 9	4 5	3 8	11 0
September	6 6	7 5	6 4	5 0	4 11	5 1	3 8	3 2	10 11
October	5 0	5 0	5 2	3 3	3 6	5 7	4 7	4 1	9 7
November	2 11	2 7	1 11	6 5	3 10	9 5	6 3	3 7	11 5
December	3 9	2 8	2 5	9 0	—	7 0	7 6	5 4	19 5
1947—									
January	3 0	—	3 5	4 0	8 7	4 9	7 7	—	16 5
February	4 2	—	5 1	3 2	—	5 8	10 4	—	12 8
March	3 5	—	2 8	5 3	—	7 5	16 8	20 0	24 5
April	2 7	2 5	2 1	6 7	5 1	7 8	13 4	4 11	27 1
May	3 0	3 3	2 5	9 0	4 0	4 8	8 10	18 8	23 8
June	2 11	3 4	4 3	5 9	4 4	3 7	7 1	17 11	16 7
July	6 0	4 6	5 2	5 8	5 5	4 11	6 0	11 7	15 11
August	10 2	9 1	8 0	5 0	3 8	3 4	9 3	7 7	13 7
September	3 9	5 4	2 8	3 6	3 0	2 10	6 4	7 0	9 0
October	2 9	2 6	1 9	4 11	2 11	3 9	7 7	7 7	11 5
November	3 0	1 9	4 6	6 5	4 8	5 0	9 9	5 10	11 6
December	2 7	3 4	5 1	7 3	7 5	9 6	5 8	7 9	11 8
1948—									
January	2 10	3 6	5 4	3 4	5 4	5 8	4 10	7 10	13 1

(*a*) Weights of bags vary, but on the average are approximately as follows:—Johannesburg, 130 lb. Town, 90 lb.; and Durban. 120 lb.

Average Prices of Cabbages, Cauliflower and Tomatoes on Municipal Markets.

Season (1 July to 30 June).	Cabbages (Bag). (*a*)			Cauliflower (Bag). (*a*)			Tomatoes (Trays 15 lb.).			
							Johannesburg.			
	Johannesburg.	Cape Town.	Durban.	Johannesburg.	Cape Town.	Durban.	N.M. No. 1.	Other.	Cape Town.	Durban.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1938–39	3 10	3 0	3 10	3 0	1 8	3 5	2 2	1 3	1 8	0 10
1940–41	5 10	4 8	7 1	3 11	4 3	5 3	2 7	1 6	2 1	1 2
1941–42	8 10	5 5	11 5	5 9	5 7	7 11	3 1	1 9	2 3	1 6
1942–43	5 6	5 11	9 1	5 0	5 9	7 6	3 4	1 10	2 1	2 7
1943–44	11 1	7 4	17 6	9 2	6 2	12 1	5 5	2 9	3 7	2 0
1944–45	9 7	6 11	13 5	7 5	6 6	9 8	4 1	2 0	2 10	1 9
1945–46	10 1	7 1	10 11	8 4	6 5	11 1	4 11	2 4	3 4	1 7
1946–47	6 7	6 4	10 6	8 4	11 2	10 5	4 3	2 5	2 8	2 5
1946—										
July	7 11	1 10	9 9	8 6	—	11 3	2 2	1 1	2 3	1 0
August	5 9	2 1	7 1	8 9	3 2	11 1	2 5	1 3	1 11	0 9
September	4 11	2 5	5 8	9 6	4 0	13 7	3 2	1 9	2 2	1 1
October	5 6	8 0	7 0	15 10	13 7	12 0	4 5	1 9	2 8	0 11
November	5 7	11 5	12 0	13 4	15 1	—	5 2	2 1	3 4	1 1
December	8 9	9 11	11 11	11 10	—	—	4 8	1 11	3 0	1 10
1947—										
January	9 0	12 3	5 9	11 3	23 8	—	5 0	2 0	2 11	1 6
February	11 4	14 10	14 3	12 5	15 2	—	5 6	2 3	3 4	3 1
March	12 0	17 2	17 6	12 1	16 6	31 5	7 10	3 9	4 0	2 9
April	7 1	14 9	16 0	6 2	14 2	11 9	6 2	2 9	3 8	2 3
May	6 8	10 4	12 1	7 0	9 9	9 5	7 4	3 8	2 10	2 5
June	6 1	8 3	8 6	8 5	8 8	9 0	5 2	2 5	4 4	1 11
July	6 0	6 9	7 0	7 4	7 6	9 10	3 8	1 8	2 3	1 9
August	4 1	7 3	5 5	5 1	10 3	5 5	3 10	1 11	2 9	1 3
September	4 5	7 0	4 4	9 1	10 0	5 9	7 2	3 9	4 1	1 3
October	5 5	7 0	4 7	16 9	16 2	—	5 0	1 10	2 8	1 2
November	4 8	5 2	6 4	6 11	11 3	—	4 11	1 11	3 5	1 1
December	4 11	6 0	8 0	10 8	11 0	—	5 2	1 11	4 4	1 9
1348—										
January	4 8	7 11	11 3	8 3	21 8	—	4 8	2 0	3 5	1 11

(*a*) Weights of bags vary, but on the average are approximately as follows: For cabbages—Johannesburg, 150 lb.; Cape Town, 105 lb.; and Durban, 90 lb. For cauliflower—Johannesburg, 100 lb. Cape Town, 65 lb. and Durban, 85 lb.

Average Prices of Dry Beans, Dry Peas and Manna Seed.

Season and Month.	Johannesburg (a). Dry Beans—per 200-lb. Sugar.	Yellow Sugar.	Small White.	Kidney.	Cow Peas.	Johannesburg (b). Dry Peas—200-lb Green Feast.	Mixed.	Chinese.	Johannesburg (c). Manna Seed. 200 lb.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1938–39	25 0	26 11	20 7	24 2	16 9	—	—	—	15 6
1939–40	21 11	27 3	19 10	21 2	13 11	—	24 11	18 1	17 5
1940–41	30 0	30 7	27 1	27 11	16 8	—	26 6	25 3	21 10
1941–42	32 10	34 8	28 3	28 3	19 8	—	34 9	29 6	35 0
1942–43	34 0	42 1	24 11	24 2	25 8	—	35 5	104 3	49 0
1943–44	49 6	50 7	28 2	32 1	29 11	—	56 1	107 5	55 8
1944–45	88 7	86 10	64 6	70 6	39 6	—	70 11	63 0	39 3
1945–46	101 0	107 5	77 0	82 8	62 10	—	76 4	55 6	57 4
1946–47	72 11	82 9	55 1	61 9	42 9	70 5	48 11	38 6	47 10
1947—									
January	61 4	64 5	51 8	51 4	38 11	56 8	44 11	34 6	48 10
February	44 3	56 5	40 11	44 3	33 6	42 4	41 10	33 8	32 9
March	47 1	51 6	47 9	49 3	35 1	80 10	44 11	37 4	33 9
April	55 7	57 9	50 10	56 1	42 3	75 8	55 5	39 9	40 11
May	50 8	56 10	41 10	50 0	38 2	94 8	50 2	38 11	31 8
June	50 4	56 2	42 10	49 0	41 2	94 11	47 3	35 10	35 2
July	45 9	54 3	42 2	48 9	38 7	65 6	46 3	42 10	33 5
August	52 4	56 3	45 7	49 2	43 0	69 8	51 5	44 4	36 3
September	52 10	59 0	47 2	53 9	46 7	92 7	58 9	48 3	33 11
October	51 0	57 1	48 9	50 9	45 6	65 11	57 6	47 11	33 1
November	56 0	53 9	58 1	58 2	47 3	57 5	54 2	52 9	32 9
December	51 4	55 2	56 6	59 2	47 3	57 10	56 1	52 9	33 5
1948—									
January	53 9	56 4	58 3	57 11	42 10	52 4	47 4	44 0	33 0

(a) Seasonal year for Dry Beans, 1 April to 31 March.
(b) Seasonal year for Dry Peas, 1 November to 30 October.
(c) Seasonal year for Manna Seed, 1 June to 31 May.

Average Prices of Lucerne, Teff Hay, Nyati, Millet, Buckwheat, Sunflower Seed and Kaffircorn.

Season and Month.	Cape Town. Lucerne. 100-lb.	Johannesburg. Lucerne. Cape. 100-lb.	Lucerne. Tvl. 100-lb.	Teff Hay. 100-lb.	Nyati. 200-lb.	Millet. 200-lb.	Buck-wheat. 150-lb.	Sunflower Seed. (Mixed). 100 lb.	(a) Kaffir-corn K1.+K2. 200-lb.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1938–39	4 0	3 10	3 1	2 7	—	—	9 5	—	12 11
1939–40	3 4	3 0	2 5	2 6	12 11	12 3	10 0	6 4	9 0
1940–41	4 3	4 2	3 5	3 3	14 11	30 2	10 10	6 2	16 3
1941–42	5 8	5 7	5 2	4 7	22 11	32 9	13 7	6 6	19 2
1942–43	7 4	5 5	6 0	5 5	29 5	56 7	18 3	15 10	24 10
1943–44	7 3	5 4	5 6	4 5	23 10	49 1	20 9	16 4	21 4
1944–45	7 2	6 4	5 4	4 9	18 11	31 3	21 0	13 2	18 8
1945–46	7 7	6 6	5 11	4 8	56 5	52 11	37 6	19 10	24 8
1946–47	7 5	5 11	5 7	4 3	38 6	27 9	34 0	30 9	45 9
1947—									
January	7 5	5 10	5 11	3 8	41 11	—	28 9	36 5	48 9
February	7 5	5 0	4 10	3 11	36 8	14 11	19 9	36 1	40 11
March	7 5	6 3	5 10	3 11	34 10	30 0	22 0	38 10	40 8
April	7 8	7 1	6 10	4 7	36 6	30 3	24 8	38 7	38 4
May	7 9	6 8	7 6	4 6	33 10	30 6	22 8	31 10	33 5
June	8 3	6 9	6 9	4 7	34 11	34 6	23 2	31 8	33 0
July	6 9	7 4	7 1	5 1	33 11	34 9	27 7	31 7	30 5
August	8 4	7 4	6 5	5 2	32 6	—	29 2	31 6	32 7
September	7 8	7 5	—	4 10	32 7	—	31 8	29 3	38 2
October	7 8	5 11	6 2	4 7	33 7	29 6	32 4	32 11	38 11
November	6 3	6 7	6 7	5 4	35 2	—	30 5	32 4	37 5
December	8 6	5 7	5 0	5 6	32 10	13 6	32 0	32 9	35 4
1948—									
January	6 2	5 1	5 10	5 2	32 4	—	34 1	31 0	35 3

(a) Kaffircorn prices f.o.r. Producers Station. Seasonal year 1 June to 31 May.

Index of Prices Paid for Farming Requisites.

Year and Month.	Imple-ments. (*a*)	Ferti-lizers. (*b*)	Fuel. (*c*)	Bags. (*d*)	Feeds. (*e*)	Fencing Material. (*f*)	Dips and Sprays. (*g*)	Building Material. (*h*)
Basis—								
1936–38...	100	100	100	100	100	100	100	100
1942......	123	157	140	206	139	229	117	168
1943......	144	171	154	237	154	239	127	179
1944......	161	184	156	307	155	240	134	184
1945—								
January...	159	204	156	310	161	225	136	181
April......	159	204	156	311	164	224	136	181
July.......	159	204	156	321	172	225	135	180
October. ..	159	204	146	321	169	225	135	179
1946—								
January...	155	204	146	314	172	218	135	174
April......	152	204	146	304	166	213	134	174
July.......	152	199	130	308	168	214	134	176
October....	154	199	131	319	164	215	134	177
1947—								
January...	157	199	131	325	163	216	134	184
April......	156	199	123	325	171	224	137	186
July.......	159	201	123	379	173	230	137	190
October....	163	201	123	383	171	246	137	196
1948—								
January (j)	167	194	122	398	159	242	137	197

The following is the composition of the above groups. (The items are weighted according to their respective importance):—

(*a*) Ploughs, planters, seed-drills, harrows, cultivators, ridgers, mowers, binders, hay rakes, silage cutters, hammer mills, separators, windmills, shares, land sides, mouldboards, mowers, knives, pitmans, guards.

(*b*) Superphosphate, ammonium sulphate, muriate of potash.

(*c*) Petrol, power paraffin, crude oil, grease, lubricating oil.

(*d*) Woolpacks, grain bags, sail twine, binder twine.

(*e*) Mealies, oats, lucerne, teff, dairy meal, laying mash, pig meal, bonemeal, salt.

(*f*) Fencing wire, standards, baling wire.

(*g*) Bordeaux mixture, lime sulphur, arsenate of lead, cyanogas, cooper's sheep dip, Little's dip, Tixol cattle dip.

Corrugated iron, deals, cement, lime, flooring boards.

Preliminary.

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[*Photo on Cover* : Meteorological Services (Pretoria).]

[NOTE.—Articles from *Farming in South Africa* may be published provided acknowledgment of source is given.]

G.P.-S.13316—1948-9—8,400.

Fertility in Rams.

D. J. Engela, Professional Officer, Sheep and Wool Research,
Grootfontein College of Agriculture, Middelburg, C.P.

THE potential annual loss to farmers in South Africa as a result of skipping in ewes is rather heavy. This problem has been investigated at the Grootfontein College of Agriculture for the past eleven years. At the beginning of this investigation attention was focussed more particularly on ewes, but later it was found that poor fertility in rams is also an important cause of the poor lamb crops obtained and that a large percentage of the infertile rams could be eliminated by a clinical examination of their testicles.

The most common abnormalities of the testicles, causing infertility, are briefly the following:—

(1) *Varicocele.*—This abnormality can be felt on the seminal cords above the testicles, being to the touch like a soft swelling or a thickening on and around the seminal cord or cords. The size of these lumps may vary from that of marble to that of tennis ball.

Typical German Merino Rams. [*Photo : E. Adler*].

(2) *Epididymitis.*—Most farmers are familiar with the round lump, about the size of a walnut, on the lower end of the testicle. This body is known as the tail of the epididymis and in normal rams is easily distinguished from the testicle itself. A thin body runs from the tail of the epididymis testis. round the outside of the tesicle to the top where it joins another slightly enlarged portion known as the head of the epididymis which in turn, is connected with the seminal cord. In the normal state the head and body of the epididymis can hardly be felt, but the cauda is prominent and fairly soft, like a relaxed muscle.

In epididymitis the affected portion becomes enlarged and is usually either soft or hard.

 [*Continued on page* 282.

FARMING IN SOUTH ... AFRICA

VOL. 23 APRIL 1948 No. 265

Editorial:

Stock Farming in the Cropping Areas.

THE extreme desirability of including one or more branches of stock farming in the farming systems practised in those regions of this country where crop production is preponderant, is being advocated to an increasing extent on the grounds that continuous cropping leads to depletion of the soil, ultimately making cropping unremunerative. The importance of the inclusion of stock farming, as an important subsidiary branch, in the farming organization of the cropping areas, does not seem to be fully appreciated as yet. A brief summary of the specific functions and advantages of such a policy would therefore be appropriate.

Every farm, even in the grain areas, requires a certain minimum capital investment in the form of buildings and equipment such as, for example, fencing for paddocks, dams, windmills, etc. If the returns from the farm organization can be increased, these fixed expenses are more easily borne. By the inclusion in the farming organization of one or more branches of stock farming the returns are increased, frequently without an increase in these fixed expenses, and more often than not, with only a slight additional capital outlay on improvements and equipment. Stock farming, therefore, increases the returns of the farming system without bringing about a proportionate increase in the fixed expenses.

No farmer can rely solely on seasonal labour and every farm requires a minimum quantity of permanent labour. This labour is more effectively utilized in stock farming, especially in the winter months when crops require little or no attention and stock can be fed. Labour costs are, therefore, reduced in terms of farm returns.

For profitable cereal production rotational cropping systems are necessary, some of the crops essential for inclusion being field crops suitable only as stock feed. These fodder crops, more especially the hay crops, are inexpensive and bulky products, their transport costs being out of all proportion to their value. Such products are processed and concentrated by stock into human food with a high value per unit of weight, capable of being marketed at a lower cost than in their original form.

On all grain farms there are by-products—straw, chaff, stover and even weeds—with little or no market-value. The direct market-value of the natural pasturage of these farms is negligible too. These by-products and pasturage are processed by livestock into animal products with a high market-value, such as meat, wool, cream, etc. Hence stock utilize by-products or inferior farm products effectively.

In consequence of the variability of natural conditions, there is an enormous fluctuation in the yields of agricultural crops, more particularly of cereal crops, from year to year. Stock, on the other hand, are far less affected by climatic changes. A drought in the cropping areas capable of causing a dismal crop failure will not even approximately destroy or impair the productivity of stock. Seldom are the crops in our cropping areas so seriously affected by drought as to be unusable as stock feed. In any event, stock feed can always be purchased, even in

an exceptional drought, but rain can never be purchased for the the cultivation of crops. Thus, while keeping the fluctuations of farm incomes within limits, stock farming also lessens the hazards attached to farming.

The production of the majority of crops is carried out strictly according to seasons and consequently the farmer receives most of his income simultaneously. The production flow of most classes of stock, particularly that of dairy products and poultry, is more continuous. Even in the case of a seasonal product such as wool, a between-season income can be derived by the sale of sheep. Hence, where livestock are kept, the farmer's income is distributed over the entire year, thus facilitating the meeting of his current labour and household expenses. Stock farming not only yields a more secure but also a more regular income.

In our rotational cropping systems fodder crops, particularly legumes, are essential to the maintenance of soil productivity. If fed to stock, their value as soil improvers is enhanced, inasmuch as the sale of livestock and livestock products drains the farms of a far smaller percentage of the valuable plant nutrients than the sale of the fodder in its original form, particularly with judicious utilization of the manure. Hence livestock are indispensable to the maintainance of soil productivity in the cropping areas.

The inclusion of stock farming in the farming organizations promotes selfsufficiency on the farm. The returns from a poor crop are often insufficient for covering the expenses incurred and the farmer still has the additional expense involved in the purchase of the necessary animal products for his household. A few branches of stock farming, on however small a scale, would assist in decreasing his financial burden. Every farm in the cropping areas ought to be self-sufficient in respect of its meet and dairy products.

Then, too, biologically speaking, animals are closer to man than plants and a more intimate personal relationship exists between man and beast than between man and plants. The sight of wilting crops brings to mind our loss of income, whereas the sight of waning livestock makes our hearts go out to the suffering animals too. Those of us who farm with stock, look upon our farming enterprise as more than a mere business concern, but rather as a mode of life that we love, and once we are imbued with that spirit, we have progressed a long way on the road to success.

Our national welfare is bound up with the survival of our cropping areas, more particularly of the true grain areas, but the maintenance and economic expansion of these areas are to a large extent dependent upon the incorporation of one or more stock-farming enterprises in the farming organization and the maintenance of the correct relationship between them. Adherance to this policy will not only ensure greater profits to the farmers themselves, but will also redound to the advantage of the country as a whole.

(Prof. W. H. van der Merwe, Stellenbosch-Elsenburg College of Agriculture)

Demonstration Courses for Farmers.

Two identical three-day demonstration courses for Farmers will be given at the *Grootfontein College of Agriculture, Middelburg, C.P.*, in *Sheep and Wool, and Veld Management.*

1st Course from 6 to 8 July 1948.

2nd Course from 13 to 15 July 1948.

Application forms and further particulars obtainable from the Principal of the College.

Seed-Infesting Insects.

Dr. M. J. Oosthuizen, Entomologist, Division of Entomology.

NUMEROUS dangers threaten the seed industry of the world. These include physical factors such as moisture, temperature and light, and biotic factors which embrace bacteria, fungi and insects. Of the biotic factors stored grain insects undoubtedly remain one of the most important hazards and cause enormous losses all over the world each year.

Insects infesting stored grain, not only impair the germination capacity of seed, but also harm the reputation of the seed merchants, since growers hesitate to buy from seedsmen suspected of handling infested seed. It is therefore incumbent on all interested concerns to exercise constant vigilance against all the factors which may affect the viability

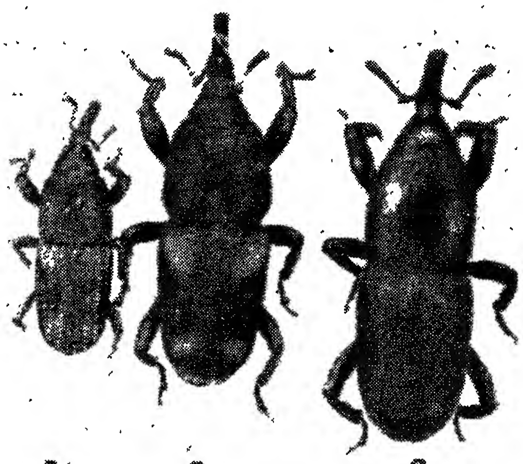

FIG. 1.—Maize and granary weevils.—(1) maize weevil (small strain) ; (2) maize weevil (normal) ; (3) granary weevil. Note four light brown spots on wing-pads of maize weevils.

of their seed. Vigilance against stored grain insects is undoubtedly one of the main ways in which better relations between seedsmen, seed producers and the public may be encouraged.

Main Groups of Insects Involved in Seed Damage.

Insects attacking seed may be classified into different groups according to their methods of feeding. The different groups comprise, firstly, those which complete their development inside the seeds; secondly, those that feed almost exclusively on the germ of the seed, and thirdly, a group possessing piercing-sucking mouthparts which they use for puncturing and sucking sap from the developing seed.

It is the purpose of this article to discuss a few typical examples in each of these groups.

Group 1.—Insects that complete their development within the Seed.

It is obvious that infestation of seed by this group is not always apparent from a superficial examination. The eggs of the insects are either laid in small holes excavated in the seed, or are laid loosely between seeds, or in other cases are firmly attached to seeds by a cement-like fluid. The immature stages complete their development inside the seeds, and provided developmental conditions are favourable, adults usually emerge about one month after the initial infestation. Damage may be caused by both larvae and adults or by the larvae alone. In most cases many individuals develop from one seed, while in a few isolated cases only a single individual will develop per seed. Where many insects develop per seed, such seed becomes honey-combed as a result of the feeding of the larvae. Unless the embryo of such a seed is destroyed, germination will not be impaired. The resultant seedlings will, however, be of low vitality because of the lack of necessary nourishment. Furthermore, if damaged seed is planted and germination is delayed because of unfavourable temperature conditions, decay may set in as a result of the entry of bacteria and fungi through the wounds or holes made by the emerging insects.

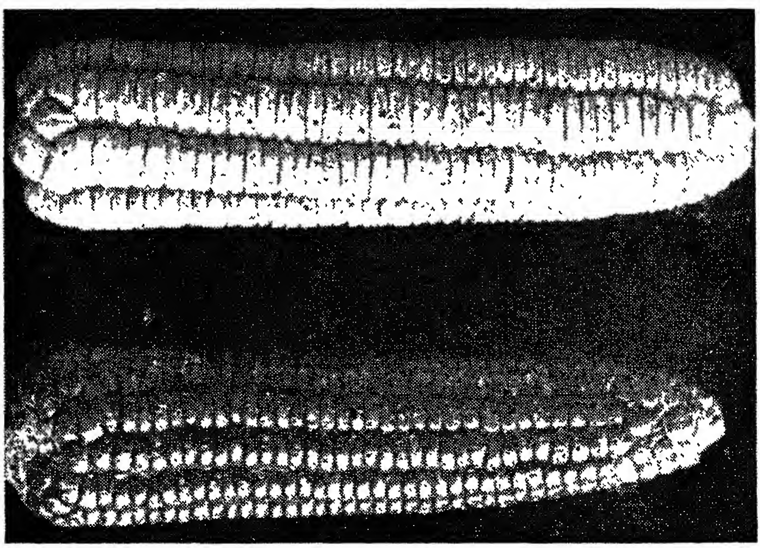

FIG. 2.—Injury to maize ears as a result of field infestation by maize (rice) weevils.

Typical examples of this group are the maize or rice weevil (*Calandra oryzae* Linn.), the granary weevil (*C. granarius* Linn.), the Angoumois grain moth (*Sitotroga cerealella* Oliv.) and the lesser grain borer or Australian wheat weevil (*Rhizopertha dominica* Fab.). Insects attacking leguminous seed such as the bean bruchid (*Bruchus obtectus* Say), the pea bruchid (*B. pisorum* Linn.), the cowpea bruchid (*Callosobruchus chinensis* Thun.) and a small wasp-like insect referred to as the lucerne seed chalcid (*Bruchophagus funebris* How.) are also important members of this group. (See the accompanying illustrations of these insects. Figs. 1, 2 and 3.)

The *maize and granary weevils* or snout beetles are the two primary seed pests of the Union. The females lay their eggs in small excavations in the seeds and complete development takes place inside the seeds. Damage is done by both larvae and adults. The maize weevil has well-developed wings and will fly to maize, wheat and sorghum fields where

pre-harvest or field infestation is caused. At Potchefstroom during May and June 1944, as many as 404 maize weevils were reared from a single Kroonstad Robyn ear which had been harvested from a field situated in the immediate neighbourhood of an infested grain store. This record clearly demonstrates the serious condition which field infestation may assume. The development of the immature stages of the weevil can only be completed in grains which have reached the dough stage.

The *granary weevil*, on the other hand, has no functional wings and its attack, and consequent damage, is solely confined to seed in storage.

According to information gleaned by the inspection of elevator screenings, the distribution of these two species in the Union is of interest. Apparently the presence of the maize weevil is largely confined to the western areas of the Transvaal and Orange Free State, while the granary weevil is the predominating species in the eastern areas of these two provinces. It would appear from available information that the former species is limited in its distribution by the low temperatures during winter and the latter species by the high temperatures during the summer months.

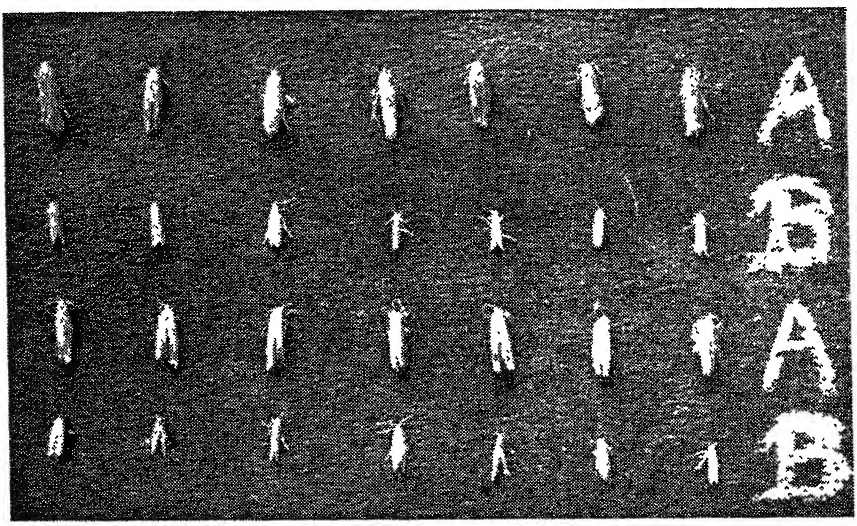

FIG. 3.—Angoumois grain moths. Series A and B were reared from maize and wheat seeds, respectively.

In the case of the *Angoumois grain moth*, damage to seed is caused by the larval stage only. The female moth is capable of flight and will also cause field infestation. At Potchefstroom field infestation of wheat is fairly prevalent. Usually only a single individual will develop in each wheat seed.

Both larvae and adults of the lesser grain borer will attack sound grain. The eggs are generally laid loosely between the seeds. While this species of insect is present in the Union it never occurs in sufficient numbers to cause serious damage to our seed reserves. Apparently its activity in this country is limited to some extent by unfavourable temperature conditions.

The bean bruchid or bean weevil (Fig. 4) is a very important pest attacking all varieties of field beans in this country. Damage is confined to the larval stage. The adult is unable to take solid food and it only lives for from 2 to 4 weeks. Apart from breeding in stored beans, females are also responsible for infesting pods in the field. In storage, eggs are

laid loosely between the seeds, and in the field, overripened pods which have split along the sutures thereby exposing the seed, are selected for oviposition. Development is completed inside the seed and numerous individuals can develop from one seed. Apparently certain varieties of beans are more readily attacked than others. It is claimed that the Lappies bean grown in the Koue-Bokkeveld area (Ceres) is immune to attack by this species. A sample of this variety procured from Stellenbosch and subjected to infestation at Potchefstroom, was readily attacked. It is therefore presumed that the bean bruchid does not occur to any marked extent in this particular area.

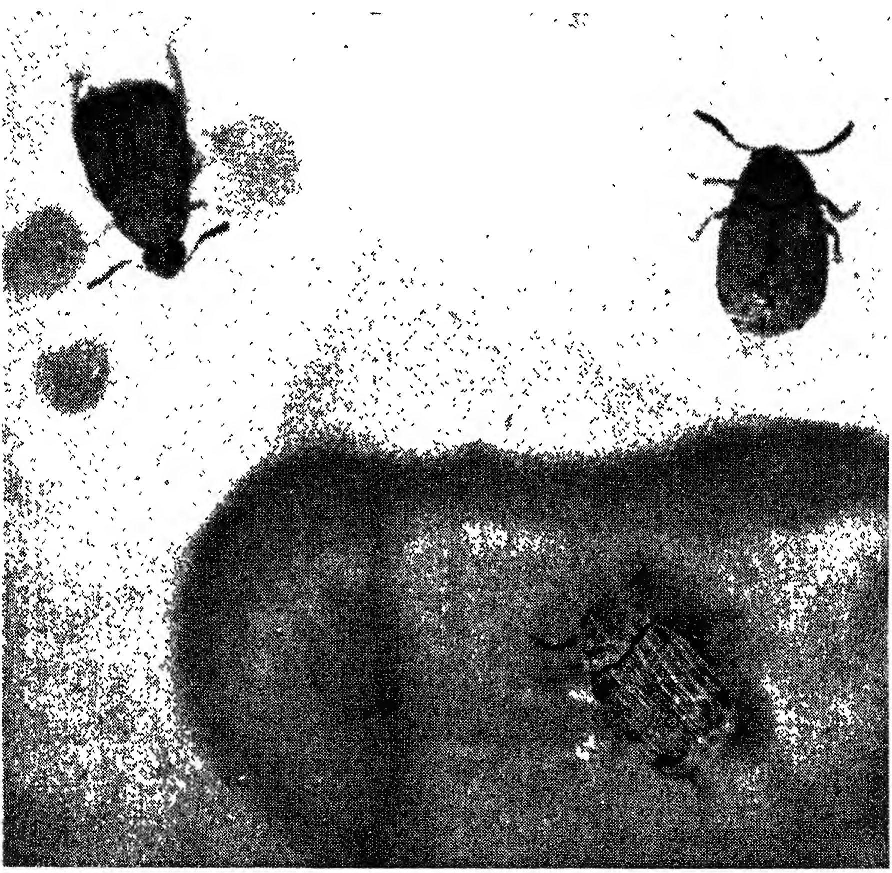

FIG. 4.—Bean bruchids.

The *pea bruchid* (Fig. 5) is a very serious pest of all peas grown for seed and canning purposes in the south-western districts (Oudtshoorn, Prins Albert) of the Cape Province, in the winter-rainfall area of the western Cape Province, south of the Hex River, and in parts of Natal (Weenen area). Consequently seed merchants no longer buy their supplies from these areas. Practically all commercial seed has, during the past 10 years, been obtained from parts of the north-western Cape (Upington, Kakamas, Marchand), where this pest is still unknown.

Infestation is confined solely to growing peas in the field. No breeding takes place in stored peas. The female attaches her eggs to the outside of the pea pod. After hatching the larva bores through the wall of the pod into the young seed. Only one individual will develop from each

seed, but this is generally sufficient to ruin such seed for planting purposes. In a test conducted by Mr. J. P. F. Sellschop, Seed Analyst, germination was only 22 per cent. in infested seed as compared to 98 per cent. in clean sound seed. Only one generation of the pea weevil occurs per year. This species overwinters in the adult stage. At Potchefstroom, adults have been kept alive for 7 months, i.e. from March to September, on honey water, but without food they perish at the end of two weeks.

The *cowpea bruchid* (Fig. 6) is another pest of major importance in the Union. Apart from cowpeas it will also attack peas. Attempts to breed this bruchid in field beans have thus far failed. Because of their high oil content soybeans are immune to attack. Infestation takes place both in the field and in storage. Field infestation may reach serious proportions during certain seasons. For instance, field infestation of cowpea seed at Kroonstad reached 20 per cent. in February 1940.

In contrast to the bean bruchid, the eggs of this species are firmly attached to the seed by means of a glue-like substance. Many individuals may develop from a single seed. The germination of seed may be seriously impaired, depending on the degree of infestation. Experiments have revealed a pronounced reduction in the germination capacity of cowpeas infested with 3 or more eggs per seed after 12 days, and with 1 or 2 eggs per seed after 18 days. These observations are well illustrated in Fig. 13.

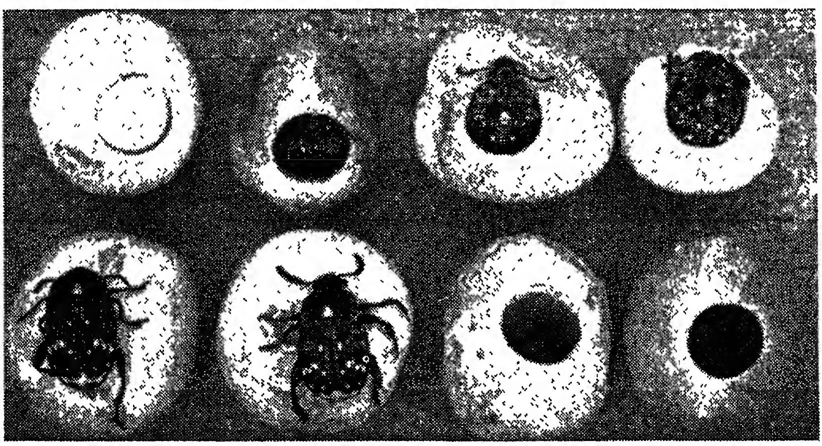

FIG. 5.—Pea bruchids.

The lucerne-seed Chalcid occurs to a certain extent in the Oudtshoorn area and in the Great Karroo. Infestation takes place in the field. The larva consumes the interior of the seed, leaving only a thin outer shell. Only one individual is produced from each seed. In overseas countries the seed chalcid is often so abundant as to render the production of seed unprofitable and this has sometimes been the case in South Africa.

Group 2.—Insects that Feed almost Exclusively on the Embryo of Seed.

The most important examples of this group are the larvae of the Indian meal moth (*Plodia interpunctella* Hbn.) (Fig. 8) and the larvae and adults of a shiny black beetle called the Cadelle (*Tenebroides mauritanicus* Linn.) (Fig. 10).

While these insects will devour other portions of the seed they show a special preference for the germ. This type of damage is especially noticeable in the case of infested wheat. While such grain is not harmed for milling purposes, it is rendered useless for seed purposes.

Another pest which shows a special preferance for the germ of moist seed is the grain mite (*Tyroglyphus* sp.). In certain countries where humid conditions prevail, damage to seed may be very severe. Owing to the relatively dry conditions under which our grain is stored this pest is only of minor importance in the Union.

Group 3.—Insects that Puncture Developing Seed.

Various species of plant bugs belonging to the families Coreidae and Pentatomidae fall in this group (Fig. 11). Damage is especially prevalent in the case of cereals, beans and cowpeas. In the case of wheat, injury becomes apparent from the time the berries begin to form until shortly before maturity. When attacked in the early stage, punctured seeds shrivel up or become deformed. Such seeds usually fail to germinate. When ears in the dough stage are attacked, a characteristic yellow area is formed around the black feeding puncture. This phenomenon is especially pronounced in the wheat varieties, Red Egyptian and Rooi Kleinkoring. Damage to wheat is generally more severe during dry seasons.

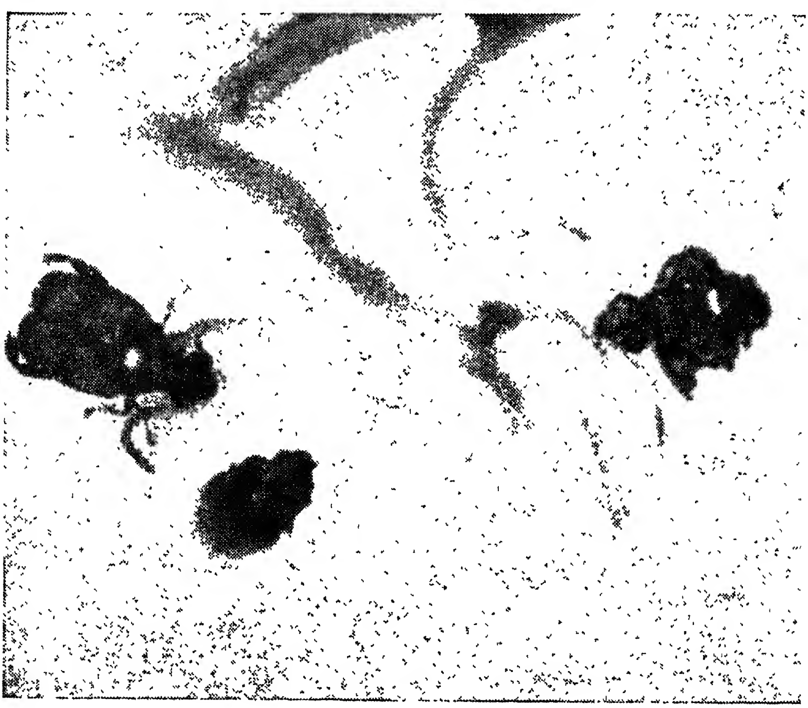

FIG. 6.—Cowpea bruchids.

Following a report received from a Milling Company in Senekal in 1939 in connection with injury to the baking quality of wheat by sucking insects, this aspect was investigated at Potchefstroom during the seasons of 1939 and 1940. The effect of the feeding of five different species of stink bugs was determined. Special attention was given to the injury caused to different varieties of wheat kernels, as well as to flour strength made from different blends. In one experiment *Nezara viridula* Linn. adults were confined in cellophane bags on Kruger wheat ears at the rate of one insect per 2 ears for a period of 2 weeks. The percentage of injured kernels ranged from 17·7 to 31. In certain cases many feeding punctures were observed on a single kernel. Pelshenke tests

failed to reveal any significant deteriorations in the baking quality of flour blended with 5 or 10 per cent. of flour from injured wheat (Fig. 12).

Damage to developing bean and cowpea seeds by this group of insects may be very serious during dry seasons. Bean seed from pods on which adults of the *Coreid, Aeanthomia tomentosicollis* Stn. had fed, failed to germinate. Different varieties of punctured bean seed which had been collected at random in a field were submitted to the Seed Analyst for a germination test. The results are given in Table I.

TABLE I.—*Germination capacity of bean seeds punctured by sucking insects.*

Variety of Bean.	No. of Seeds used.	Percentage Germination.
Khaki	300	63·3
Long Oval	200	72·0
Painted Lady	200	46·0
van Zyl	400	72.0
Natal Sugar	400	31·0
Round Speckled Sugar	300	87·5
Red Speckled Sugar	400	45·0

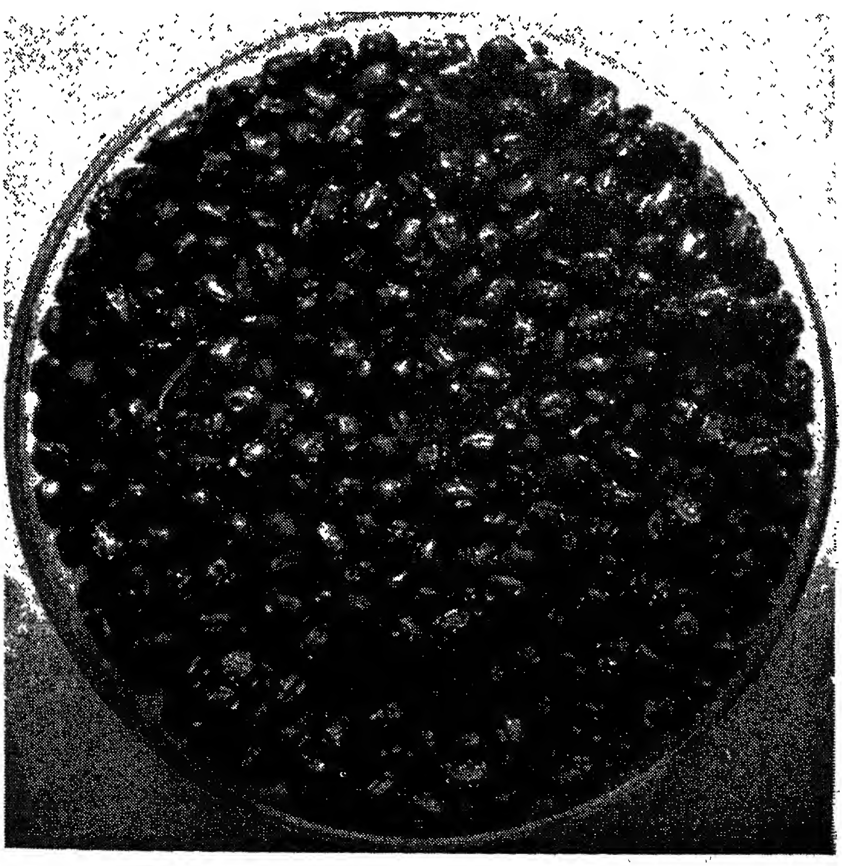

FIG. 7.—Seed badly damaged by the cowpea bruchid. Note profuse egg-laying on some seed.

With a germination capacity of over 90 per cent. for normal seed this table clearly demonstrates the harmful effect of the feeding of these insects on certain bean varieties.

Conditions Favouring the Existence and Development of Insects in Seed Stores.

Temperature, moisture and an abundance of loose seed are the chief factors affecting the abundance of insects in seed stores.

While the minimum winter temperatures which obtain in the Union are not fatal to these insects, they nevertheless will retard their development. There is an optimum temperature for each species at which its life cycle is completed in the shortest time. The maize weevil can develop between temperatures ranging from 15·2° to 34° C. At the lower limit development from the egg to the adult is completed in about 7 months, while it is completed in 25 days at 29° C. At higher temperatures development becomes abnormal. Temperatures of 40° C. or higher will prove fatal to all insect life in a relatively short time.

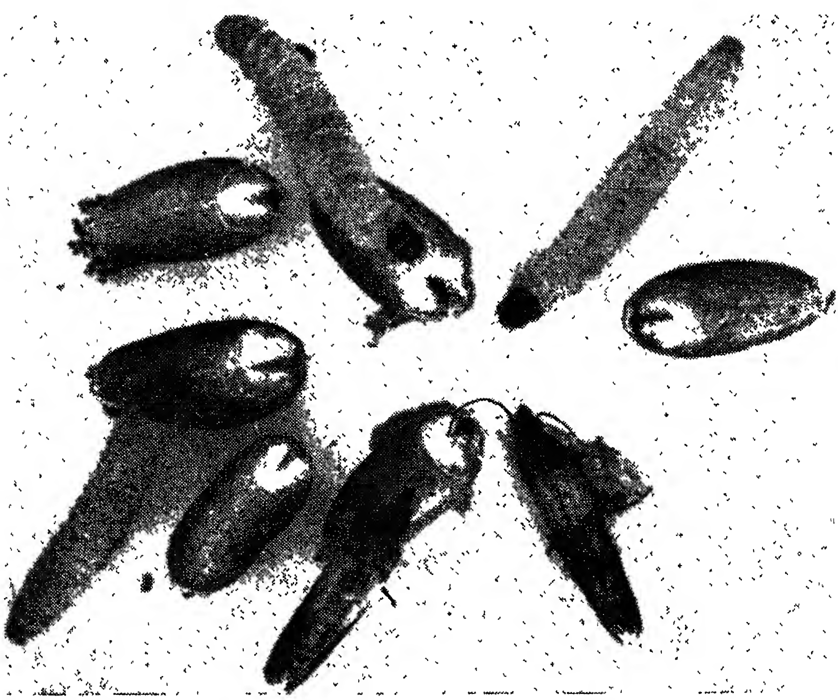

FIG. 8. The Indian meal moth. Note degermed condition of wheat seed by larvae.

Moisture is of prime importance in this connection. According to experiments conducted in Australia, the maize weevil is unable to multiply in wheat with a moisture content below 10·5 per cent. The lower limit for the lesser grain borer is 9 per cent. The moisture content of grain has also a pronounced influence on the rate of multiplication of the maize weevil. At 25·5° C. its rate of increase in wheat of 14 per cent. moisture content is 179 times in one generation as compared with 13 times in wheat of 11 per cent. moisture content. Furthermore, the percentage mortality during its development from egg to adult was only 7 per cent. in wheat of 14 per cent. moisture content as compared to 88 per cent. in grain of 10·5 per cent. moisture content. Apart from its harmful influence

on the rate of insect development and on survival, dry grain is less attractive to weevils. Consequently it does not become as easily contaminated.

An abundance of food is also an important consideration in the rate of multiplication of this species. At 25·5° C. the number of eggs laid at a density of one insect per 10 wheat seeds was 265, as compared to 384 at a density of 1 insect per 50 grains.

The Control of Seed-Infesting Insects.

Since the price realized for sound seed is almost double that of commercial grain, extra precautionery methods to inhibit the progress of all factors which cause deterioration will prove remunerative. The various

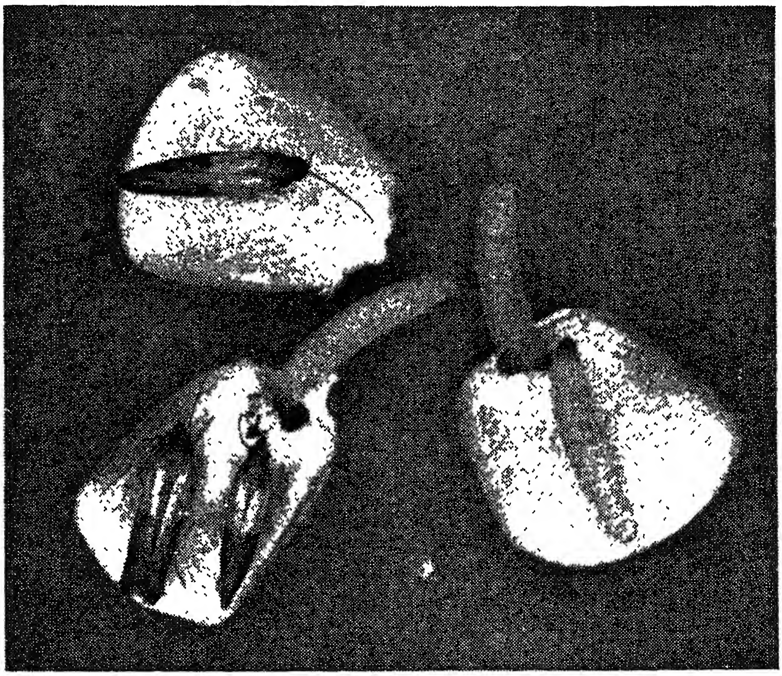

FIG. 9.—The Indian meal moth. Larvae and moths on maize.

control measures which may be applied are described briefly below. The conscientious application of one or more of these measures will yield sure, safe and enduring protection of seed.

I. The Encouragement of Seed Production in Special Zones or Areas.

In view of the fact that sound Lappies bean seed can be produced in the Koue-Bokkeveld area, it is presumed that this area is relatively free from bruchids (weevils). Consequently, it should be possible to produce bruchid-free seed of other bean varieties in this locality.

It has been established that the pea bruchid is absent in the Kakamas-Upington area. Hence, for the past 10 years all commercial pea seed is grown in this area.

Because of favourable developmental conditions in the Lowveld of the Transvaal, grain is subjected to weevil contamination all the year round. It is, therefore, not advisable to keep seed obtained from this area.

On the other hand, seed preservation in the Highveld of the Transvaal and the eastern Orange Free State becomes a problem during the summer months only. Furthermore, field infestation by maize weevils is very rare, with the result that seed need not be treated for contamination before storage. In these areas, the preservation of wheat presents a greater problem than that of maize. This is due to the fact that wheat seed has to be stored during the summer months, i.e. after threshing in December until sowing time in April, while maize is stored during the colder months from around June to the time of planting in October.

II. The Elimination or Reduction of Pre-harvest Infestation.

Since certain species of insects are capable of attacking grain in the field, it is imperative that all sources which make pre-harvest infestation possible be systematically removed before the crop begins to ripen. This procedure is urgently necessary in the grain areas of the western Transvaal and north-western Orange Free State.

FIG. 10.—The Cadelle. Larvae and adults feeding on maize.

In these areas fields intended for seed purposes should be located as far as possible from seed stores.

III. Sanitation Measures in Seed Stores.

After harvesting, seed should be thoroughly cleaned of immature shrivelled seed and impurities which dry out with difficulty and occupy valuable space. The writer's attention has frequently been drawn to the prevalence of Indian mealmoth larvae in celery and other vegetable seeds which contained impurities.

Only dry seed should be stored. Moist grain is very susceptible to weevil attack and also deteriorates rapidly. For instance, the germination capacity of wheat seed with a moisture content of 15·3 per cent. may be reduced to 20 per cent. after a storage period of 20 days.

Since cool conditions are a primary requisite for the safe storage of seed, all seed storage rooms should be situated on the south side of larger buildings where no direct sunlight will reach them. To facilitate

the drying out of seed and to permit the free circulation of air, bags of seeds should preferably be packed in long narrow stacks on poles well away from floors and walls.

Do not store seed in a tank which is kept outside in the sun, since such seed will be exposed to widely fluctuating temperatures. High temperatures will drive off moisture vapour which condenses at night causing mouldiness of seed.

Since sanitation undoubtedly remains the foundation of grain insect control, the seed storage room should be kept scrupulously clean. Examine the seed reserves regularly and, should infestation become apparent, remove the infested samples, then fumigate or spray with a 5% D.D.T. solution.

All receptacles used for seed purposes should be closed so as to exclude moisture and any possible insects, some of which are very small. New and old seed should never be mixed in the same receptacle.

IV. The Treatment of Seed.

(1) *By mechanical appliances.*—Screening and winnowing have since time immemorial been resorted to for the processing of seed. As a certain proportion of infested material may be of the same size as sound seed, gravity separators are often used for further purification. By means of these appliances infested and sound seed are separated on the basis of their specific weights.

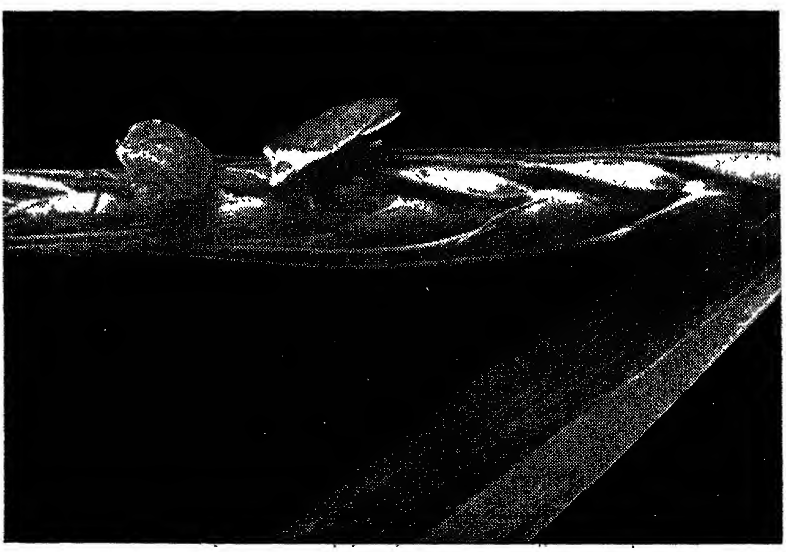

FIG. 11.—Pentatomids (stinkbugs) feeding on a wheat ear.

While these machines will remove adult insects and badly damaged seed as well as impurities, they will not remove newly infested seeds. Nevertheless, processed seed may be stored with greater safety than uncleaned material.

(2) *By heat treatment.*—Heat treatment is the oldest and one of the most effective methods of controlling insects in stored grain. In bulk, grain is generally treated by means of specially designed heating units which are fairly expensive. The Ficksburg Co-operative Society have recently erected a simple and effective grain-drying plant in which each of the two sides of a bag is heated by means of hot air for various periods depending on the drying temperature.

Small quantities of seed may be treated successfully by spreading it in thin layers in an oven and heating to a temperature of 50° to 60° C. for several hours. Exposing seed in thin layers to the rays of the sun during hot weather is also very effective. Table 2 gives data obtained from observations made by exposing maize seed at Potchefstroom in trays 1, 2 and 3 inches deep, respectively.

TABLE 2.—*Temperatures recorded in maize seed exposed on a sunny day (December 22nd,* 1944).

	Time and Temperature.				
	10 a.m.	10.10 a.m.	11.15 a.m.	1 p.m.	2 p.m.
Soil surface.....	50°C	55°C	63°C	65°C	60°C
One inch layer..	28°C	29°C	46°C	54°C	53°C
Two inch layer..	28°C	29°C	46°C	53°C	52°C°
Three inch layer.	28°C	28°C	38°C	48°C	49°C

Needless to say an exposure under the above conditions is sufficient to destroy all insect life. Because of the slow rate of heat penetration in grain it is advisable that the depth of exposed grain should not exceed 2 inches.

FIG. 12.—Feeding puncture of a stinkbug on a wheat seed.

The moisture content of seed is an important consideration where heat treatment is resorted to. For instance, maize seed of 7·5 to 11·6 per cent. moisture content can be safely subjected to a temperature of 57° C. for 3 to 6 hours. If grain with a moisture content of 12·9 per cent. is exposed to the same conditions, germination will not be injured, but weak seedlings will result. Wheat, barley, Sudan grass and Johnson grass seed dried to 0·1 per cent. moisture content can be treated for 6 hours to 100° C. without materially affecting their viability. The germination capacity of seed which has been subjected judiciously to heat will in no way be impaired.

(3) *By fumigation.*—There is a great divergence of opinion as regards the influence of fumigants on the germination of seed. This may be due

to results obtained on a single experiment with insufficient data as to details.

Where field infestation of seed is suspected it is necessary to dry the grain thoroughly and then to fumigate. Ordinarily, fumigation will produce a slight decrease in viability. This decrease is especially pronounced where repeated fumigations have to be given. Instances are on record where an average drop of 40 per cent. was observed. In seed fumigation it is advisable to avoid a long continued exposure to a fumigant. After the required fumigation period has expired, aerate the seed and then store in insect-proof receptacles.

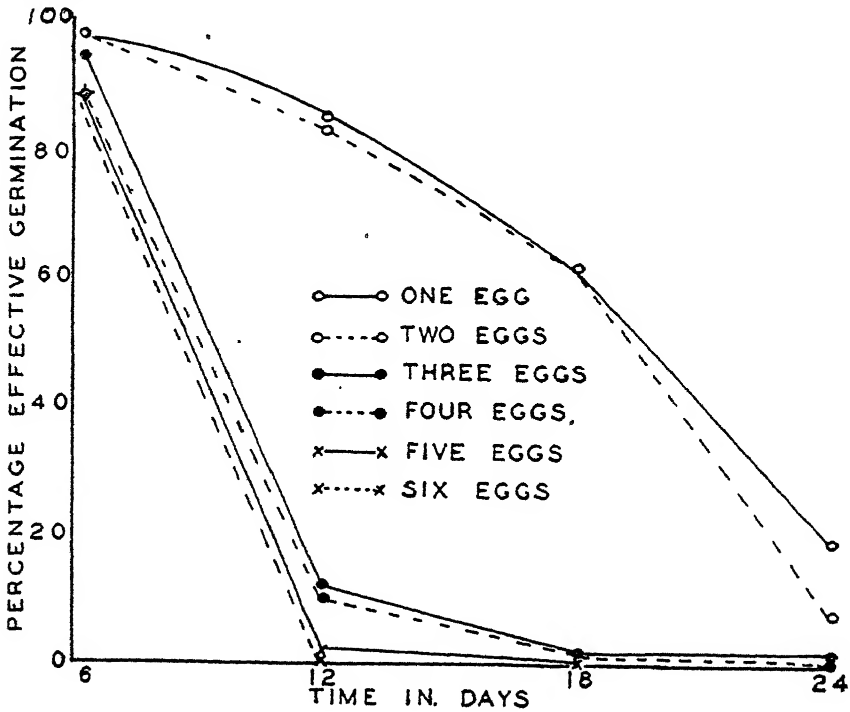

FIG. 13—Influence of different levels of bruchid infestation on the effective germination capacity of cowpeas.

Photos : Dr. M. J. Oosthuizen.

Chemicals noted for their injurious effect on seed are ammonia, ethylene oxide, sulphur dioxide, chlorine gas, chloropicrin and carbon bisulphide. The latter two will only impair viability under certain conditions. Perfectly safe fumigants to use are ethylene dichloride, carbon tetrachloride and cyanogas.

Factors which determine the influence of a fumigant on germination are: moisture content, variety and age of seed, concentration and length of exposure to the fumigant and temperature. Under certain conditions the germination capacity of maize with a moisture content of 14·5 per cent. will be injured by carbon bisulphide, whereas no harm will result to maize with a moisture content of 12·3 per cent. Where different varieties of cauliflower seeds were treated with carbon bisulphide it was observed that the germination of 19 varieties was lowered, 17 raised and 3 remain unaltered. Usually, old seed is more susceptable to injury than fresh seed of high vitality. The higher the temperature the more effective is a fumigant in killing the insects.

Of the various fumigants, carbon bisulphide is the most widely used. It is readily available and is used at the rate of 4 to 5 tablespoonfuls per bag (200 lb.) of seed for a period of 48 hours. It will not harm the viability of dry seed. Because of the inflammable and explosive nature of the fumes of carbon bisulphide, it should be handled with extreme care. Petrol is also effective and is used at the rate of 6 to 7 tablespoonfuls per bag for at least 120 hours. It now contains tetraethyl lead, a potent poison, and treated seed should thus not be used for consumption. Crystals of para-dichlorobenzine or napthalene may be used at the rate of 2 ounces per bag of seed. It is claimed that the continued exposure of seed to the former chemical is not safe.

(4) *By mixing seed with poisonous or inert dusts.*—In order to prevent infestation of clean seed or reinfestation of fumigated seed it may be mixed with small amounts of poisonous or inert dusts. Very effective poisonous dusts are copper carbonate or a 3% D.D.T. powder, used at the rate of 2 ounces per 200 lb. bag of seed. In view of the fact that surplus seed is ofen used for consumption it is a dangerous procedure to treat grain with such dusts.

Inert or non-poisonous dusts which have been used with some success include the proprietary dusts "Vivianite" (Russia), "Naaki" (Germany), "Almicide" (England), and "Katelsousse" (Egypt) or Capex weevil powder. Some of these, at the rate of 1 part to a 1,000 parts of grain by weight, have given excellent results. Further examples of this group are finely powdered lime and kaolin. These two dusts are used at the rate of 1 to 2 lb. per bag of seed. While the protection of seed is not complete these latter dusts will nevertheless limit the continued breeding of weevils or other insects in seed.

A dust which is claimed to be non-poisonous and which is also very effective for protecting seed reserves is Gammexane. The amount of dust used depends on the benzine hexachloride content of the dust. Dust with a B.H.C. content of 1·0 per cent. is used at the rate of 3·5 ounces per bag.

Non of the dusts mentioned above will destroy immature stages of insects present within seeds, and it is, therefore, advisable to fumigate before mixing with the dust should infestation be suspected.

Insecticidal efficiency of dusts is influenced by intrinsic hardness, particle size, moisture content of grain, relative humidity of the air, and temperature as well as age and species of the insect concerned.

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Please Note.

"Duck Farming", Bulletin No. 248, which was out of print for a time, has been reprinted and is now obtainable from the Editor of Publications, Pretoria. Price 6d. per copy.

"Poultry Farming", Bulletin No. 241, and "Nutrition of Poultry", No. 260 are out of print and will be reprinted. An announcement will appear in this journal when stocks are available again.

The Use of Preservatives Against Wood-Destroying Insects.

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THE widespread and ever increasing destruction of the woodwork in buildings and houses in this country, by subterranean and drywood termites and woodboring beetles, has received, of late, considerable publicity in the press. That the damage by this complex of wood-destroying insects is now reaching alarming proportions is at last beginning to be realized by the public generally, as well as by architects, builders and all those intimately connected with the timber and building trades. This realization has resulted in a steadily increasing demand for treated timber for new building projects.

For some years past the Government has realized the ever increasing seriousness of the position, as evidenced by the fact that the treatment of all coniferous (softwoods) timber for structural purposes is now compulsory in the magisterial districts of Bellville, Cape Town, Port Elizabeth, Simonstown, Somerset West and Wynberg—(*vide* Government Notices No. 569 of 15th March, 1946, and No. 2681 of 20th December, 1946).

Recent investigations have revealed serious and extensive damage by the West-Indian drywood-termite, *Cryptotermes brevis* * in Durban and Port Elizabeth, and this will, no doubt, eventually mean the compulsory treatment of all classes of timber intended for building purposes in these two centres.

The increasing demand for treated timber has naturally aroused great activity in the field of wood preservation, and a number of wood preservatives of varying effectiveness are now on the market. It must be emphasized, however, that the effectiveness of a wood preservative depends not only on the toxic properties of the chemical or chemicals of which it is composed, but also on the manner in which it is applied to the wood. A preservative possessing excellent protective properties may prove utterly worthless if the wrong method of application is employed.

In this connection attention must be drawn to the fact that under the powers conferred by the Government Notices referred to above, in the areas mentioned, no wood preservative nor method of application may be employed without the prior approval of the Chief, Division of Entomology. While the Division has no jurisdiction over the rest of the Union in this respect, this is not to say that the use of treated timber is not desirable. To protect buildings against the ravages of the subterranean termites in the Orange Free State, Transvaal and Natal, all sub-floor timbers and wood coming in contact with the floor should be treated, and property owners should for their own benefit insist upon this being done. Where treated timbers are specified, it is as well to be certain that an approved preservative and method of application has been used.

The Division will have no hesitation in condemning the use of preservatives and methods of application which are of no value. Any person using such preservatives and methods of application in those

* A bulletin dealing with this pest, and the method of its control has been prepared by Mr. W. G. H. Coaton, and will be published in the near future.

areas over which the Division has jurisdiction will incur the risk of prosecution. It may be as well, therefore, to make it plain that the Division will not consider approving of any preservative unless the full chemical formula of the preservative, together with proportions and types of solvents and diluents used, is submitted. This information will be regarded as strictly confidential.

As a guide to those who are concerned with the preservative treatment of wood and to those who specify treated wood for new buildings and for replacements in old buildings, reference will be made to the wood preservatives and methods of application, approved by the Division in terms of the relative Government Regulations.

Information given in connection with the various methods of treatment recommended, together with the absorptions and penetrations regarded as optimum, and much other data were obtained from the Forest Products Institute with which this Division is closely associated in its work on insect control.

Only approved preservatives in general use at the present time, or those likely to be used in the immediate future, are mentioned. It must not be inferred that these are the only preservatives which may be used.

Wood Preservatives.

Wood preservatives may be classified as follows:—

Class A.—Creosote and Carbolineum.

Creosotes and carbolineums used in wood preservations must conform with Specification No. 17 of October 1943, issued by the South African Standards Bureau.

Impregnation by the vacuum-pressure or the hot-cold open tank process *only* is approved of. Treatment by immersion in the cold preservative, or applying the preservative by means of a brush or sprays is not permissible.

The minimum absorptions which be accepted are: For timbers in contact with the ground or damp foundations, or timber used under particularly adverse conditions: 8 lb. per cubic foot for pine and 5 lb. per cubic foot for hardwood with full sapwood penetration. For timbers not in contact with the ground, but which may be exposed to weathering and leaching: 4 lb. per cubic foot for pine and 2 lb. per cubic foot for hardwood with optimum penetration.

Class A 2.—Creosote and Fuel Oil.

Should a mixture of creosote and fuel oil be used, the mixture should not contain less than 60 per cent. creosote. The same method of application and absorptions, as given for Class A preservatives, should be used.

Class A 3.—Gas-tar Creosotes.

Gas-tar creostes are generally less toxic than coal-tar creosotes, but are to be preferred to water-soluble preservatives where permanence is a factor of importance, and they are more satisfactory for all purposes where their oiliness is not a disadvantage. No standard specification is available, but they should be applied as laid down for coal-tar creosotes.

Class B.—Metallic Salts in Aquous Solutions.

Preservatives of this class consist essentially of a preservative dissolved in water to give a solution free from deposit. They may consist of a single salt or of a combination of salts. *Their use for treatment of timber in direct contact with the ground or damp conditions,*

or when exposed to weathering and leaching, is not recommended. They may be used for treating timber for use under cover or for timber out of doors which *will be kept well painted* after treatment.

For all preservatives of this class impregnation by vacum pressure or hot-cold tank process *only* is approved. Immersion in the cold preservative or application by means of a spray or brush is not permissible.

(1) Wolman Salts.

Wolman salts comprise a group of patented preservatives, all essentially fluoride-phenol mixtures, but varying considerably in composition. In the latest developed salt, Tanalith, arsenic has been added to give treated wood additional protection from insect attack.

The following absorptions are recommended by the manufacturer and have been approved:—

(*a*) 0·3 lb. of Wolman Tanalith preservative per cubic foot of sapwood for ordinary interior use.

(*b*) 0·35 lb. per cubic foot of sapwood for exterior timbers (with the proviso that such timber is kept well painted).

(*c*) Not less than 0·4 lb. per cubic foot of sapwood for exterior timber in contact with the ground; (this specification is not officially recommended).

(2) Zinc Chloride.

Zinc chloride is a water soluble salt used extensively for the treatment of timber in this country and in the U.S.A., in concentrations up to 5 per cent. in strength. A minimum dry-salt retention of 0·5 lb. per cubic foot of wood has been laid down to protect timber from decay.

With the increase in the number of species and in the destructiveness of wood-destroying insects, its usefulness as a wood preservative has had to be reviewed. Experience in South Africa has shown that, while it is effective against the powder-post beetle, *Lyctus brunneus,* it is relatively ineffective against the subterranean wood-eating termites.

It has not actually been proved effective against the European house-borer, *Hylotrupes bajulus,* and the West-Indian drywood termite, *Cryptotermes brevis,* and hence it cannot be recommended for use against these insects in the defined areas until further trials have been made.

(3) Celcure.

Celcure has only been used on an experimental scale in this country, but it is understood that a treating plant is shortly to come into operation using this preservative. Celcure varies slightly in its component parts, but consists essentially of potassium dichromate, copper sulphate, acetic acid or chromium acetate, and sometimes a small amount of boric acid.

Experimental results indicate it to be one of the best of the water-soluble class and when properly applied can be recommended with confidence. On account of the shallow penetration obtained, brush applications can, however, not be recommended.

Specifications for treatment have not yet been scheduled for South African conditions, but American Federal specifications have been prepared to cover the preservative treatment of wood by the Celcure process. They specify that timber so treated shall not come in contact with the ground or water unless it is first painted and has a minimum dry-salt retention of 0·5 lb. per cubic foot of wood, and where less than 85 per cent. of the sapwood depth has been penetrated, a sapwood

penetration of not less than 2½ inches. Until such time as they are superseded by official recommendations, the above specifications are approved.

Class C.—Oil-Soluble Preservatives.

These consist essentially of a solution of a preservative, (*a*) in some comparatively non-volatile solvent, e.g. diesolene, diesel oil, furnace oil, and (*b*) in a volatile oil, e.g. white spirit, power paraffin, an auxiliary solvent usually being required.

The advantages of preservatives of this class are that they are permanent and resistant to leaching and are, therefore, suitable for exterior use as well as in wood coming in contact with the ground, and re-drying after treatment is not necessary. Those in group (*b*) are usually non-staining, and wood treated with them can be painted. They are thus particularly suitable for interior use.

Although some of the oil-soluble preservatives are odourless, they should not be used on wood which is likely to come into contact with foodstuffs. Treatment with the more volatile types of solvents should not be carried out in confined spaces where there is lack of ventilation.

(1) Pentachlorophenol.

The following solutions *only are approved*:—

(i) Not less than 5 per cent. pentachlorophenol in white spirit. As it is not possible to dissolve 5 per cent. pentachlorophenol in white spirit, an auxilliary solvent is required. *In addition the solution must contain sufficient of a plasticising agent to prevent "blooming".*

(ii) Not less than 5 per cent. pentachlorophenol in a 50-50 white spirit power-paraffin mixture. Here also an auxiliary solvent and *plasticising agent* will probably be necessary. A pure power-paraffin solution is not approved.

(iii) F.P.I. pentachlorophenol solution:

5 per cent. pentachlorophenol.
5 per cent. rosin.
20 per cent. Shell diesel oil.
70 per cent. power paraffin.

(iv) Not less than 5 per cent. pentachlorophenol in fuel oil.

Cold Immersion Method.—Solutions of type (i) were originally devised for the treatment of infested wood in situ. It was then discovered that these solutions possessed exceptionally good penetrative powers in softwood timbers, notably pine, when the wood was immersed in cold solutions. This discovery came at a time when the Division was faced with the problem of recommending an economical and effective method of protecting coniferous timbers against the attacks of *Hylotrupes bajulus*, when there was complete lack of treating equipment in the country. This resulted in the recommendation of the cold immersion treatment for the protection of softwood timbers *only*, against infestation by *H. bajulus*. It should be noted that this method has always been regarded as a protective and not as a preservative treatment, and was only intended for timbers used indoors. At no time was it ever intended that this method should be applied to hardwoods or to softwood timbers intended for outdoor use. This fact has, nevertheless, been largely ignored, particularly in the inland centres, so that it is necessary to emphasize here *that the cold immersion method must not be used for hardwood or for softwood timbers used out in the open.*

From the point of view of efficacy, there are several objections to the use of this method, the main one being that it is impossible to control absorptions. Another objection against the method is the very primitive type of treating equipment which has been installed, usually a galvanized iron trough only large enough to take one piece of timber at a time. This makes the whole business of treating a very cumbersome and laborious one and tends to create bottlenecks. Also the actual operation is often left to the care of native labourers which incurs the risk of slip-shod treatment. Another disadvantage is that insufficient penetration is obtained in timber of large dimensions, which entails the retreatment of the tember after it has been processed, and adds materially to the cost.

Only solutions (i) and (ii) may be used in this method and the minimum immersion time should be tree minutes.

This method is not recommended for protecting wood against infestation by *Cryptotermes brevis,* as optimum penetration is here required.

A variation of the dipping tank is the spray tunnel, whereby wood passing through an enclosed cylinder, is exposed to jets of spray from all sides. This method is open to the same objections as above.

Low-Pressure Method.—While the Division does not at the moment contemplate withdrawing its approval of the dip-tank method, it is apparent that this method has served its purpose and the Department would prefer that the attention of those concerned be directed to more efficient equipment with consequent improved impregnation. This can be provided by the low pressure process recently evolved by the Forest Products Institute, from which full particulars can be obtained. This method, whereby timber is subjected to oil soluble preservatives under pressures varying from 10 to 20 lb. per square inch, is suitable for all classes of timber, and is to be highly recommended as an economical yet efficient method of impregnating timber. *It is the only approved method of treating hardwoods using Class C (b) preservatives.*

The vacuum pressure or hot-cold tank method must be used with Class C (*a*) preservatives, e.g. solution (iv).

Absorptions and Penetrations.—The following *minimum* absorptions and penetrations are advised for the pre-treatment of timber with pentachlorophenol solutions, provided that not less than a 5 per cent, solution is used. These requirements should be strictly adhered to if the desired results are to be obtained.

(*a*) 1½ lb. to 2 lb. per cubic foot (0·07 to 0·1 lb. dry salt per cubic foot) and a minimum sapwood penetration of ⅓ inch. This would be primarily for the prevention of attack by the powder-post beetle (*Lyctus brunneus*) and the European house borer (*Hylotrupes bajulus*), provided the treated surface is not removed by planing, sawing, etc. It should give a certain amount of protection also against termites and decay.

(*b*) 3 to 4 lb. per cubic foot (0·15 to 0·2 lb. dry salt per cubic foot) and a minimum sapwood penetration of ¾ inch for wood that is to be exposed to the weather, termites and decay, but which is not in contact with the ground.

(*c*) 5 to 8 lb. per cubic foot (0·25 to 0·4 lb. dry salt per cubic foot) depending upon whether the wood is a hardwood or a softwood and on its sapwood content, which should be penetrated to at least 85 per cent. of its volume, for wood in contact with the ground and exposed to any wood-destroying agency, except fire. Posts, poles and construction timber would be involved.

(2) Copper Napthenate.

Copper napthenate when dissolved in various oil solvents is an excellent wood preservative, possessing fungicidal and insecticidal

properties equally as good as pentachlorophenol. It has the advantage over the latter of not being irritating to the skin and mucous membranes, but possesses the disadvantage of colouring the wood and therefore cannot be considered for finished timber. Wood treated with copper napthenate can, however, be painted, varnished or stained.

The use of this preservative has been greatly restricted in this country in the past, because of the difficulty in obtaining supplies and the high price of existing proprietary solutions, of which the concentrations are unknown. These proprietary solutions are apperently designed entirely for brush treatments and therefore concentrations are probably unnecessarily high.

Prices are now being considerably reduced and are now nearing the range which will make impregnation of timber with this preservative an economical proposition.

Concentrations and Absorptions.—Tests are now being conducted to determine the correct concentrations and absorptions for use under South African conditions. It is possible, therefore, to give only tentative specifications at this stage.

These will, no doubt, be superseded in due course, but until then the following solutions may be recommended:—

(*a*) 5 per cent. copper napthenate (approximately 0·5 copper) in white spirit.

(*b*) 5 per cent. copper napthenate (approximately 0·5 copper) in 50-50 white spirit-power paraffin.

These may be applied by the cold-dip immersion method, mentioned above, for the treatment of the sapwood of coniferous timbers for protection against wood-boring beetles. The low pressure process is advised, however, for hardwoods and for protection against drywood termites.

The minimum absorptions advised for pre-treatment with these solutions are: 5 to 8 lb. of a 5 per cent. solution per cubic foot (0·025 to 0·04 lb. copper per cubic foot). This is for wood intended for interior purposes only. Penetration of sapwood should not be less than $\frac{1}{3}$ inch for mill work and joinery and $\frac{3}{4}$ inch for structional timbers.

Higher absorptions and penetrations will be required for timber used out in the open.

(3) Zinc Napthenate.

This preservative has not been tested sufficiently anywhere to enable safe recommendations to be made.

Being colourless, is is particularly useful for interior fittings, and until more is known of it, it should be restricted to this use only.

As it is less toxic than the copper salt, higher concentration will be necessary. Solutions in white spirit only are recommended.

General Remarks.

Practically all the chemicals and combinations of chemicals mentioned above, used for protecting wood from insect attack are poisonous to human beings. Some of them, such as the creosotes and oil-soluble preservatives, are inflammable, and some are especially dangerous.

These chemicals can however, be used without danger if ordinary precautions are taken. Storage of large amounts of poisonous substances by the layman should be avoided. Persons unfamiliar with the use of these substances should obtain expert advice before attempting to apply them.

The Composition and Use of Karoo Manure.

With Notes on Kraal Manure, Compost and Karoo-manure Ash.

Dr. E. R. Orchard and R. Ludorf, Division of Chemical Services, Pretoria.

KAROO MANURE is produced in the arid and semi-arid sheep-farming areas of the Union where the vegetation consists mainly of small drought-resistant shrubs, supplemented in some areas by quick-growing summer grasses. Arable land in the Karoo has hitherto been limited to comparatively small areas under irrigation. There has, therefore, been little inducement for using the manure where it is produced, and as a result vast quantities accumulated in the course of years. Until jackal-proof fencing and the country-wide campaign against vermin eventually made it safe for sheep to remain on the veld, it was necessary to concentrate the animals in a kraal at night. As the manure accumulated, so the walls of these enclosures were heightened until heaps of ten to fifteen feet in thickness were common.

The manure which to-day enters the trade, comes mainly from these kraals; it is the fertility drained over the course of many years from extensively grazed Karoo areas, fertility for which there was little local use, but which provided the fruit farmers, particularly those in the western Cape Province and latterly also the citrus and vegetable growers of the Transvaal, with the manure which they find so necessary for maintaining the productive capacity of their soils.

The western Cape Province farmers were the first to recognise the value of this cheap source of fertility on their sandy soils, and for years there has been a steadily increasing traffic moving westwards from the neighbouring Karoo districts, a movement of which the limit was largely dictated by railway tariffs in force at the time. When, in order to encourage the use of fertilizers, etc., the Government, in about 1940, introduced a 90 per cent. rebate on railway tariffs for approved fertilizers and manures, it suddenly became economically feasible to tap outlying areas, and the Karoo-manure trade received a sudden impetus, as farmers were quick to make use of their opportunity. An even greater stimulus to the trade was that due to the universal scarcity of artificial fertilizers during World War II, when at times it was almost impossible to import potash from the cheap European sources, rock phosphates from the Mediterranean and Far Eastern deposits, superphosphate from Holland, or sulphate of ammonia from Great Britain. It is, therefore, not surprising to find that, whereas the S.A. Railways transported 300,000 tons of manure during the twelve months ending August 1941 (pre-war figures are not available, but probably did not exceed 200,000 tons), the tonnage for the year ended August 1946 exceeded 460,000 tons. Not only did the tonnage increase considerably, but the number of ton-miles was probably more than trebled since 1939, as the manure could now profitably be drawn from further afield as the easily accessible sources became exhausted, thanks to the low railway rate and the facilities offered by the Road Motor Transport (R.M.T.) services. At a conservative estimate at least 2,500,000 tons of manure have been drawn to the

relatively small intensively cultivated areas of the Union since 1940. As will be shown later, this manure very materially assisted the Union to tide over the precarious years of inadequate fertilizer supply at a time when the call for more food and higher production was more insistent than ever before.

In view of the ever-increasing demand for manure and the gradual but steady increase in price since 1939, the time is perhaps opportune for reviewing the situation from the farmer's point of view in order to have a clearer picture of the agricultural value of the manure. The demand has already outstripped the supply, and as most of the easily accessible sources near the railways have already been exhausted, the factor governing the further exploitation of manure is the cost of transporting it by road from the farms to the nearest railway. At present this limit lies at about 35 miles, when use can be made of the R.M.T., or at about 20 miles if private transport must be used, after which transport by road makes exploitation uneconomic. There are, no doubt, still untapped reserves beyond these limits.

Preservation of the Manure in Heaps.

Although exposure to the weather necessarily leads to some deterioration in composition, there is little evidence to show that serious decomposition takes place in the heaps which are constantly compacted by the animals and consequently never heat up through fermentation to any extent. The fairly high chloride content, due to the urine, and the alkaline reaction of the heaps also exert a preservative action. There is, however, no ground for the common belief that the older the manure becomes, the better it is. The colour may darken with age, but this is no index to its agricultural value and, in general, fresh manure has the better composition. That the rate of decomposition within the heaps is extremely slow is proved by the twigs, leaves, skins and hair which, in the drier areas, may be preserved almost unaltered for periods up to 100 years. Owing to the low annual rainfall of the Karoo which in most sections rarely exceeds 15″, there is little loss due to leaching. The manure is sometimes diluted by a certain amount of sand and soil, but this is not serious. It is interesting to note that, from a profile cut through the heap, it is frequently possible to distinguish the separate layers deposited annually; it is even possible to distinguish good seasons from years of unusual drought.

Crude and Milled Manure.

When the heap is dug up the material may be sold either as crude or as milled manure. The latter is usually drier (20-25 per cent. moisture) and therefore contains more plantfood per ton than the crude manure which contains an average of 38 per cent. moisture. The milled product has the doubtful advantage that it can be applied through any suitable fertilizer drill either by itself or mixed with superphosphate, but the much higher price demanded for milled material by no means justifies its use in preference to the crude manure where bulk applications are made. The latter is sold loose by the truck-load (by computed weight), whereas milled manure is usually bagged. As the crude product is sold without reference to its moisture content, which may be anything up to 60 per cent., it will be seen that it would be fairer to sell on a volume basis, since this remains practically the same whether the manure is wet or dry.

The farmer should therefore bear in mind when purchasing an eleven-ton truck of crude manure—and one presumes that he receives

full weight—that he is probably buying about four tons of water and only seven tons of dry matter. The average moisture content of 81 samples of milled manure was found to be 23·4 per cent. When moisture exceeds 25 per cent. the material becomes difficult to mill. For this reason it is necessary to dry the crude manure by exposing it to the sun in thin layers on a drying floor before it can be milled.

PORTION OF THE UNION SHOWING THE FOUR AREAS FROM WHICH KARROO MANURE IS BEING OBTAINED.

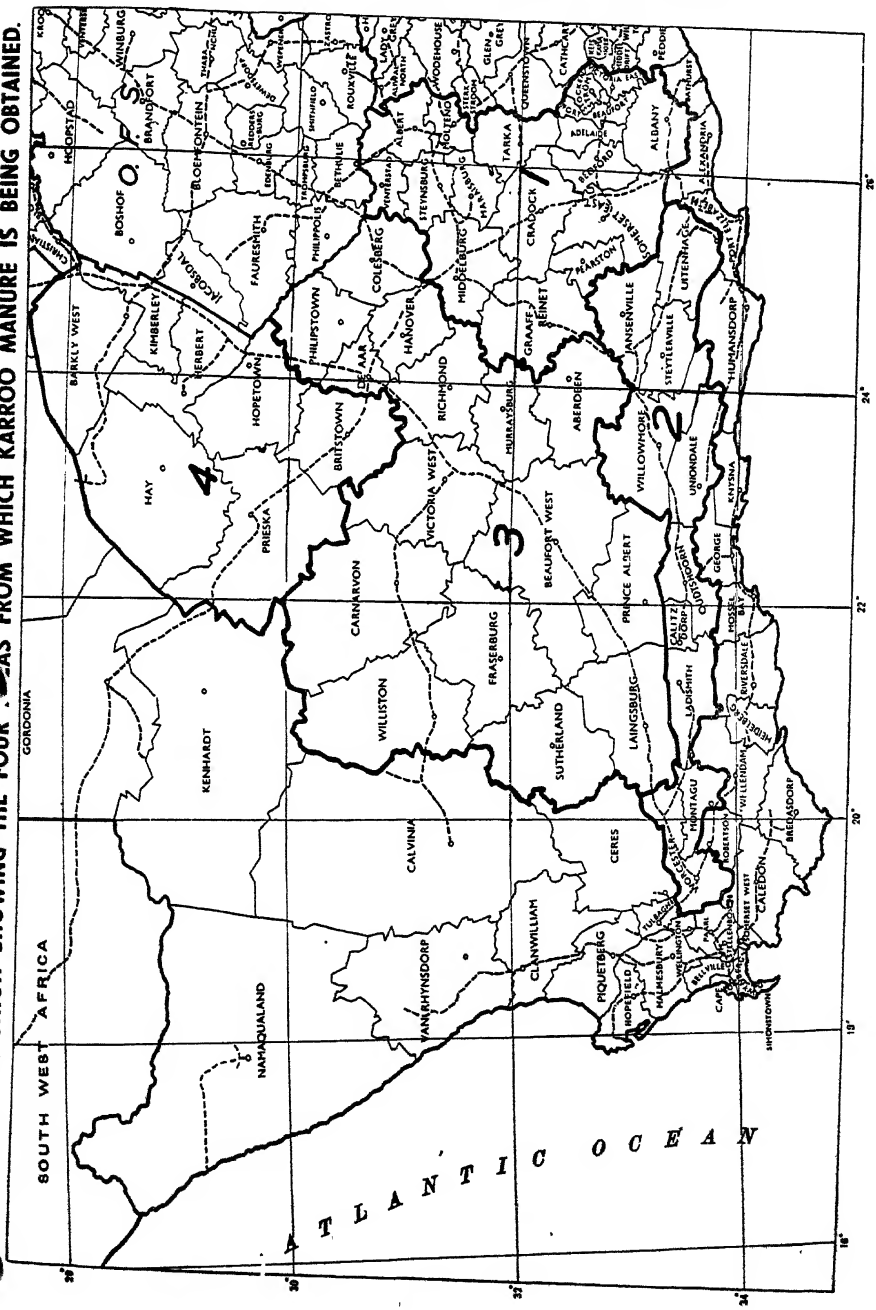


FIG. 1.

Sources of the Manure.

In Table I the total tonnages of manure loaded in the four provinces by the S.A. Railways are shown for the years 1940-41 and 1945-46. These data cover all animal manures, but is may be assumed that the figures shown against the Transvaal and Natal apply mainly to cattle kraal manure and, with the exception of small quantities of stable manure from the larger cities, the remainder applies almost exclusively to Karoo manure (sheep). The figures do not include manure used locally where it is produced, but since transport by road was severely restricted during the war the tonnages shown represent practically the entire annual turnover.

TABLE I.—*Total Tonnage of all Manures Loaded by S.A.R.*

	1940–41 (Sept.–Aug.)	1945–46 (Sept.–Aug.)
	Tons.	Tons.
Cape Province	237,581	344,751
Transvaal	38,000	108,005
Natal	20,000	4,565
Orange Free State	2,000	6,290
TOTAL	297,581	463,611*

* This total excludes 25,556 tons railed to the mandated territory of South-West Africa and to Rhodesia.

It is obvious that Karoo manure, which comes almost exclusively from the Cape Province, forms the bulk of the trade. In view of its overwhelming importance, the Cape Province was subdivided into four areas in order to obtain more detailed information on the main production centres. By grouping samples according to these subdivisions it was also possible to determine whether the manures differed in composition as a result of varying climate or vegetation.

TABLE II.—*Production of Karoo Manure by Areas (Cape Province).*

	1940–41.	1945–46.
	Tons.	Tons.
From Eastern Karoo	107,773	134,545
From Southern Karoo	78,988	52,848
From Northern Karoo	20,313	67,830
From Western Karoo	30,507	89,528
TOTAL	237,581	344,751

In Fig. 1 the boundaries of these Karoo subdivisions are shown.

From Table II it seems that production in the southern Karoo, which is well supplied with railways and which has hitherto been the principal source of manure for the western Cape Province, is already declining. On the other hand, production in the relatively untapped northern and western areas has practically trebled since 1941.

Where the Manure is Used.

The low tariff charges applying to manures make it possible to distribute the product practically throughout the country. Table III shows the areas to which Karoo manure was consigned.

TABLE III.—*Areas where Karoo Manure is used.*

	1940–41	1945–46
	Tons.	Tons.
Eastern Cape Province	14,432	22,891
Western Cape Province	153,733	156,978
Northern Cape Province	2,919	16,228
Transvaal	42,720	89,489
Natal	17,287	50,508
Orange Free State	6,490	8,059
TOTAL	237,581	344,153

TABLE III (*a*).—*Showing Where Karoo Manure is Produced and Used.* (1940-1941.)

Production in Tons.				Consigned to :
E. Karoo.	S. Karoo.	N. Karoo.	W. and Cent. Karoo.	
8,818	5,515	33	66	Eastern Cape.
49,382	55,772	19,673	28,906	Western Cape.
1,240	100	46	1,523	Northern Cape.
35,686	6,998	24	12	Transvaal.
8,782	7,996	509	0	Natal.
3,865	2,597	28	0	O.F.S.
107,773	78,988	20,313	30,507	TOTAL.

The western Cape Province is still by far the biggest market, as it uses almost as much as the rest of the Union. The Transvaal doubled its purchases in recent years, and the sugar planters of Natal who normally use large quantities of fertilizer, nearly trebled their requirements during the war. A further analysis of the 1940-41 data given in Tables II and III is shown in Table III (*a*) which reflects the movement of Karoo manure between producing and consuming centres in greater detail. The western Cape Province in that year took practically all the manure railed from the northern, western and central Karoo and nearly three-fifths of the production from the more important southern and eastern

TABLE IV.—*Main Consuming Centres in the Transvaal,* 1940-41.

	Kraal manure produced and used in Transvaal.	Karoo manure from Cape Province used in Transvaal.	Total.
Districts where used.	Tons.	Tons.	Tons.
Letaba	22,799	894	23,693
Nelspruit	3,493	17,767	21,260
Pretoria	6,242	2,592	8,834
Johannesburg and Reef	1,741	3,637	5,378
Rustenburg	2,259	2,238	4,497
Brits	698	6,306	7,004
Potgietersrust	—	6,134	6,134
TOTAL	37,232	39,568	76,800

Karoo, while the Transvaal received its main requirements from as far away as the eastern Karoo. No attempt was made to define the exact localities where manure was used in the western Cape Province, as the districts are small and compact, but in Table IV the main consuming districts of the Transvaal are shown for 1940-41.

It is clear from Table IV that the manure is used principally in the vegetable and fruit-growing districts of the low-veld, from which the larger cities, particularly Pretoria and the Reef towns, receive their supplies. Although considerably larger tonnages were used in 1946, it is unlikely that the ratios between districts have changed appreciably.

Composition of Karoo Manure.

In 1942, at a time when the trade in Karoo manure was expanding rapidly, it was found necessary to exercise stricter control over the rail movement of manure in order to make the best use of the available rolling stock which, at the time, was fully taxed in moving war supplies. In this connection a survey was conducted over a period of one week (11 to 18 June 1942) at two important rail junctions, Touws River and Rosmead, through which most of the manure must necessarily pass on its way to the consuming centres. This opportunity was used to sample large numbers of trucks so as to obtain more exact information on the composition of the manure being marketed with a view also to fixing equitable prices. In this way 236 trucks, mostly of 11-tons capacity, were sampled and it is considered that the random samples obtained in this way fairly reflect the quality of the material supplied to the trade. After thorough mixing, each sample representing one truck, was placed in a tin, sealed and submitted to the Pretoria laboratory of the Division of Chemical Services for analysis.

In addition to the 236 samples taken directly from the trucks, 96 samples were submitted from time to time by traders and farmers to the office of the Controller of Fertilizers for purposes of registration and fixation of prices; these samples, representative of all the important production areas, were also analysed and the data to be presented, therefore, cover a total of 332 samples.

The distribution of these samples was as follows:—

From eastern Karoo, 149; southern Karoo, 118; northern Karoo, 23; and western Karoo, 42.

Analytical Data.

The laboratory analysis included the following:— 1. Moisture; 2. loss on ignition; 3. total Nitrogen; 4. phosphoric oxide (P_2O_5); 5. potash (K_2O); 6. chloride (Cl); and 7. sodium (Na) (40 samples).

As expected, the values varied considerably over a wide range, and the only convenient means of characterising the samples is by means of distribution or frequency curves for each constituent in which the number of samples falling within each interval group is shown. (See Fig. 2.)

In addition to the mean value, the standard deviation is also given in Table V. When the standard deviation is large when compared with the mean, it is an indication that the particular item was subject to much variation and that the majority of samples did not fall within a particularly narrow range near the mean. The figure shown in the last column of Table V is the percentage of samples which have a value of not less than the mean, minus half the standard deviation. This percentage is an excellent indication of the risk which the purchaser takes when buying unspecified manure. Take, for example, the case of phosphoric oxide (P_2O_5); the value of 65 per cent. shown against this item indicates

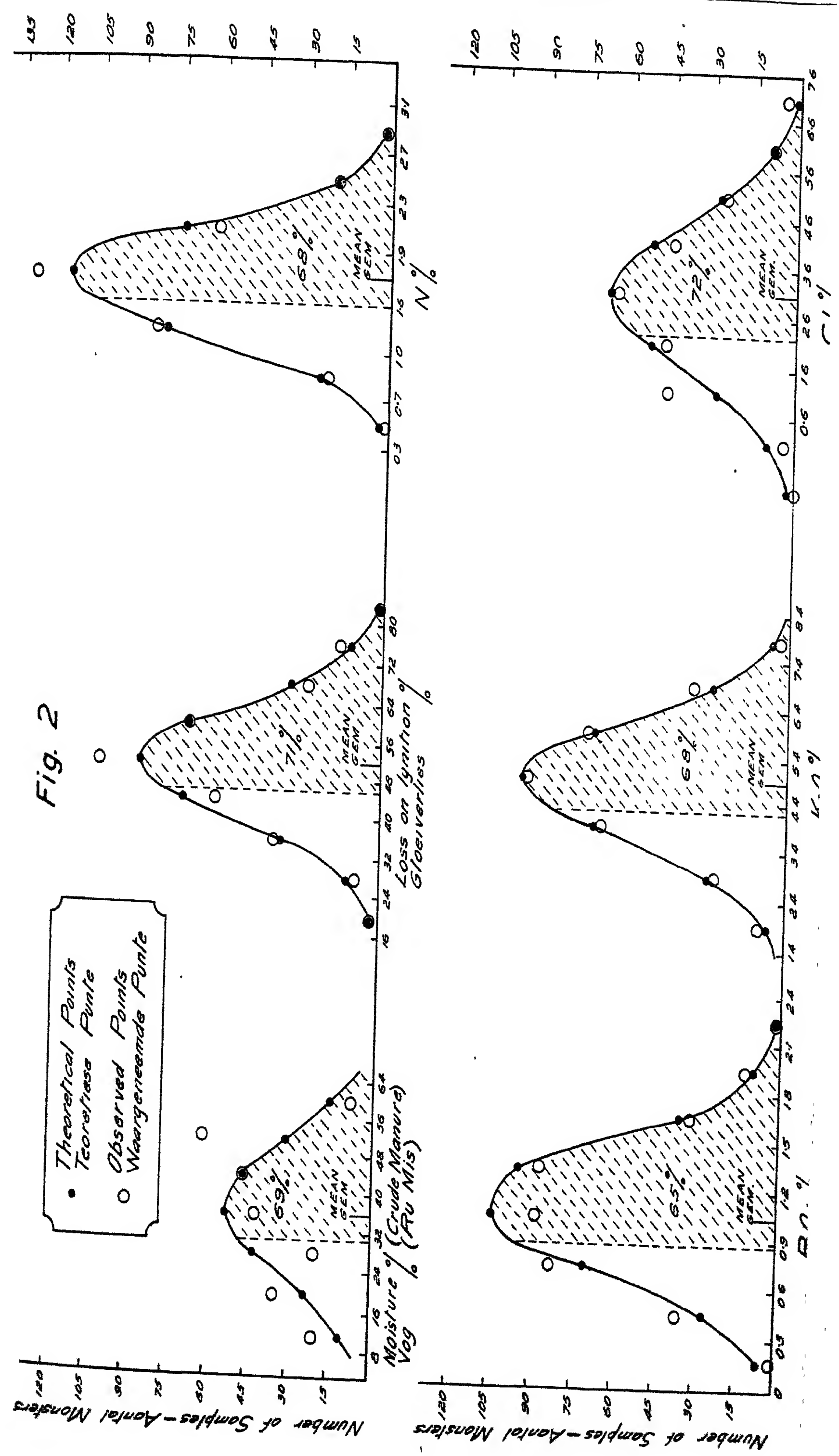


Fig. 2
Theoretical Points
Teoretiese Punte
Observed Points
Waargeneemde Punte
Number of Samples – Aantal Monsters
Moisture % (Crude Manure)
Vog % (Ru Mis)
Loss on Ignition %
Gloeiverlies %
N %
K₂O %
P₂O₅ %
CaO %
MEAN
GEM.
69%
71%
68%
65%
69%
72%

that 65 samples out of every 100 taken at random will have a minimum P_2O_5 content of $1\cdot09-\frac{0\cdot375}{2}=0\cdot90$ per cent. P_2O_5; the balance of 35 samples will contain less than $0\cdot90$ per cent. P_2O_5. In the case of loss on ignition, N, P_2O_5 and K_2O, the higher content is of course more desirable, but the opposite is the case for moisture and chloride, the last-named item being an index to the brak content of the manure.

All analyses are expressed on the basis of the oven-dried material (105° C.).

TABLE V.—*Analytical Data for a Total of* 332 *Samples of Karoo Manure.*

	Mean.	Std. Dev.	Percentage Exceeding (Mean-Std. Dev.)/2
	%	%	%
Moisture: Crude manure (233 samples)	37·7	13·9	69
Moisture: Milled manure (81 samples)	23·4	7·92	62
Loss on Ignition (organic matter)	51·9	11·72	71
Total Nitrogen (N)	1·68	0·428	68
Phosphoric Oxide (P_2O_5)	1·09	0·375	65
Potash (K_2O)	4·92	1.23	68
Chloride (Cl)	3·08	1·51	72

The curves shown in Fig. 2 give a clearer picture of the spread of values over the ranges found for each of the six constituents determined in the laboratory. The shaded portion in each case represents the proportion of the samples shown as a percentage in the last column of Table V.

In order to discover whether there was any marked difference in composition between manures from the four Karoo areas (see Fig. 1), the samples were grouped according to origin; the data are shown in Table VI.

Discussion: Composition of Karoo Manure.

Moisture.—Owing to the considerable difference in moisture content between milled and crude manure it was necessary, for purposes of statistical treatment, to group the data separately. The figures with regard to moisture are, therefore, not as reliable as data applying to the other constituents, since the number of samples from which the latter information is derived is larger.

Taking the samples as a whole (Table V) it is clear that moisture comprises more than one-third of the crude, and about one-quarter of the weight of the milled product. Manure from the eastern Karoo is considerably wetter than that from the southern and northern Karoo, while the driest product came from the western Karoo. (See Table VI.) The moisture content is an important factor for the farmer to consider when purchasing manure. The data also emphasise the point raised earlier, viz. that manure should be sold by volume and not by weight, so that the seller of dry manure will not suffer an unfair disadvantage as at present.

Loss on ignition.—This value is an index to the organic matter content of the manure. A high figure indicates that the sample is relatively free from contamination by earth or worthless mineral matter. Fresh manure usually shows a higher loss on ignition than old manure. The average value over all samples is in the neighbourhood of 50 per cent.

but there are minor fluctuations between samples from the different Karoo areas, the eastern and northern Karoo showing rather less organic matter than the other two sections.

TABLE VI.—*Composition of Manure from Karoo Sub-Areas.*

	E. Karoo.	S. Karoo.	N. Karoo.	W. Karoo.
Total No. of Samples...........	149	118	23	42
Moisture: (Crude manure)	98 samples.	74 samples.	23 samples.	42 samples.
Mean (%).................	44·3	34·0	36·3	28·3
Std. Dev. (%)..........	11·5	15·5	8·8	10·2
$\% > (M - \frac{S.D.}{2})$...	79	59	74	66
Moisture: (Milled manure)	46 samples.	35 samples.	Nil.	Nil.
Mean (%)...........	25·0	21·4	—	—
Std. Dev. (%)......	7·3	6·8	—	—
$\% > (M - \frac{S.D.}{2})$...	65	63	—	—
Loss on Ignition:				
Mean (%).........	47·8	56·8	47·7	57·2
Std. Dev. (%)........	9·5	10·0	9·1	9·1
$\% > (M - \frac{S.D.}{2})$......	70	68	57	54
Total Nitrogen (N):				
Mean (%)...........	1·57	1·77	1·96	1·79
Std. Dev. (%).........	0·36	0·43	0·45	0·35
$\% > (M - \frac{S.D.}{2})$......	74	68	58	71
Phosphoric Oxide (P_2O_5):				
Mean (%)..............	1·33	0·91	0·90	0·82
Std. Dev. (%)........	0·30	0·35	0·23	0·39
$\% > (M - \frac{S.D.}{2})$.....	69	59	79	90
Potash (K_2O):				
Mean (%)..........	5·21	4·79	4·70	4·67
Std. Dev. (%).......	1·12	1·15	0·44	1·56
$\% > (M - \frac{S.D.}{2})$...	68	64	50	66
Chloride (Cl):				
Mean (%)...........	2·53	4·25	1·30	2·58
Std. Dev. (%)........	1·06	1·32	0·49	1·39
$\% > (M - \frac{S.D.}{2})$................	61	69	55	73

Many agriculturists ascribe the good results from manuring to the beneficial effects of organic matter on soil structure, waterholding capacity, etc. A farmer applying 5 tons of crude manure per morgen is actually only applying about 3,200 lb. of organic matter. The greater part of this will decompose in the soil within a relatively short time after application, for it is largely as a result of decomposition that the plant-foods in the manure are set free in forms available to growing plants. If one assumes that one-third of this organic matter, and this is an optimistic estimate, remains in the soil one year after application in the more or less stable form of humus, then it will be realized that even a 5-ton dressing adds only an insignificant quantity of organic matter to the soil. It is difficult to see how such a small quantity of approximately 1,000 lb. can materially improve the physical properties of one morgen of soil to a depth of 9 inches which weighs approximately 6,000,000 lb., unless the dressing is repeated at short and regular intervals. Most annual crops would leave approximately the same weight of organic matter in the soil in the form of roots and stubble. In spite of the uncertainty of ascribing a monetary value to this organic matter, its worth has been assessed at 5s. per ton of dry manure.

Total Nitrogen.—As a source of plantfood, Karoo manure is valuable principally on account of the nitrogen which it contains. For this reason it follows that the manure should be applied chiefly to crops such as potatoes, vegetables, fruit and wheat which have been shown to respond to nitrogen. It has also been found that many crops respond more strongly to nitrogen when grown under irrigation than on dryland.

Maize is the outstanding example of a crop which does not readily respond to nitrogenous dressings, and Karoo manure, unless it can be obtained very cheaply, say at 10s. per ton, cannot therefore be recommended for dryland crops generally, and maize in particular. The manure is relatively rich in the more expensive nitrogen constituent and its use should be reserved for the more valuable crops which respond to nitrogen.

The mean nitrogen content of all the samples analysed expressed on the dry basis, is 1·68 per cent. N. Samples from the southern and western Karoo show an average nitrogen content, whereas those from the northern Karoo, where the rainfall is on the whole rather lower, are somewhat richer in N; those from the eastern Karoo with its higher rainfall are poorer in nitrogen.

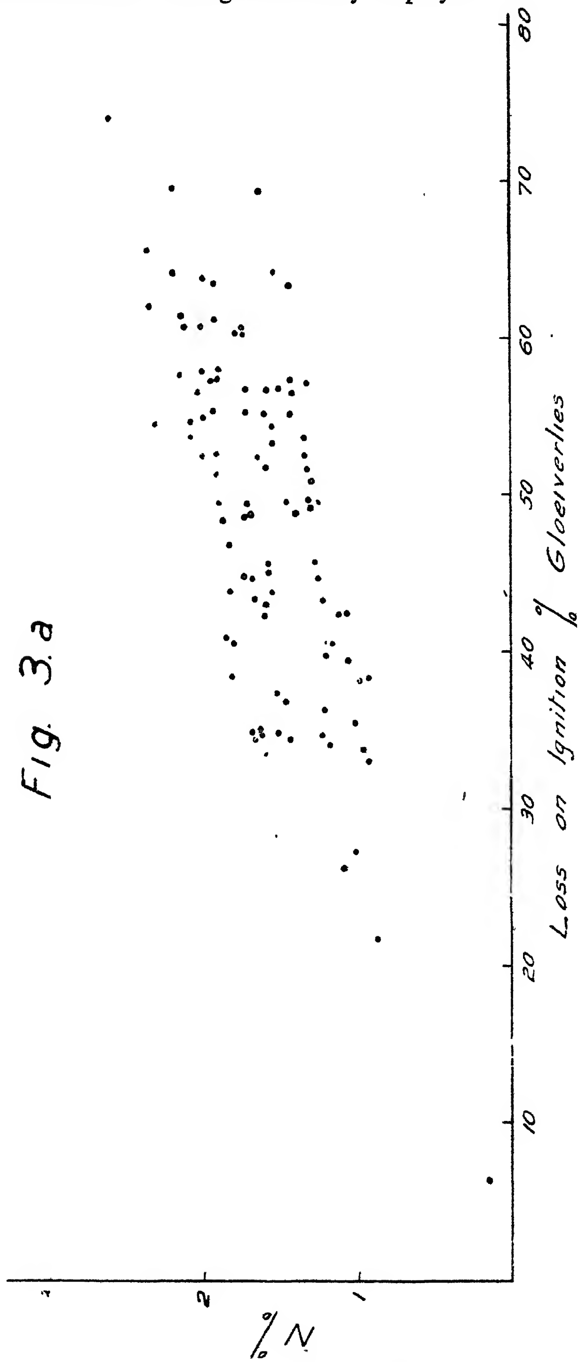
Phosphoric Oxide (P_2O_5).—The mean P_2O_5 content over all samples is slightly in excess of 1 per cent.; samples from the eastern Karoo are richer in this respect than manures from the other areas. It is not known whether this is due directly to the composition of the diet, which in this area includes a fair proportion of grass, or whether it is due to climatic or soil conditions. From the few published analyses it seems that sheep manures produced in South Africa, are somewhat poorer in P_2O_5 than comparable manures from other countries, e.g. U.S.A. This is a reflection of the well known widespread lack of phosphorus in our soils and vegetation. For the same reason local cattle manures and composts are also poorer in P_2O_5 than the products of other countries.

Experiments at the Potchefstroom College of Agriculture* have shown that, even over a period of twenty years, the response of maize (grain yield) to an annual dressing of four tons of manure per morgen is no better than that due to 400 lb. superphosphate given annually. When applied to maize grown for grain, the manure is therefore largely wasted, since it is cheaper to fertilize with superphosphate. As maize stover yields are frequently better after manure than after superphosphate dressings, there is some justification for manuring maize intended for silage. This general conclusion applies to the greater part of our maize-producing areas.

In many experiments in this country where crops have been found to respond to Karoo manure, there is little doubt that the response is largely due to the P_2O_5 present in the manure. A dressing of 5 tons crude manure per morgen supplies about as much P_2O_5 as a dressing of 400 lb. superphosphate (17·1 per cent. P_2O_5). In addition there is considerable evidence to show that the phosphate is readily accessible to growing plants which assimilate it as it becomes available during the rapid decomposition of manure in the soil. In this respect organic forms of phosphate are frequently preferred to an equivalent quantity of superphosphate, as the residual effect is usually stronger. In order to exact the best returns from manure applications it is, therefore, a sound policy to supplement the manure with phosphatic fertilizers instead of attempting to supply all the P_2O_5 requirements of the crop from the manure. By adopting this policy a more favourable balance is struck between the P_2O_5 and N applied to the crop, the nitrogen in the manure is utilised

* Saunders, A. R. 1942. A summary of investigations conducted during the period 1903–1940.

to better advantage and lighter applications may well be found to be as effective as the heavier dressings commonly employed.



Potash (K_2O).—The majority of South African soils have been shown, by analysis, to be rich in potash; it is therefore not surprising that, in spite of many field experiments, different crops throughout the country

have only rarely been shown to respond to potassic fertilizers. Analyses of crops and grasses have repeatedly shown that the locally grown product is, more often than not, richer in K_2O than the same species from other countries. For this reason Karoo manure is exceptionally rich in potash—the values found are in many instances more than double those quoted for sheep manure from overseas. The average Karoo manure contains nearly 5 per cent. K_2O on the dry material and would be a most valuable source of fertility on potash-deficient soils, but under our conditions this constituent is largely wasted. The potash applied in the form of manure will naturally serve to protect the soil against depletion of this plantfood, but if the farmer had the option it would certainly not be sound economy for him to apply such a heavy potash dressing as is represented by 5 tons of crude manure per morgen; this quantity is equivalent to more than 300 lb. K_2O per morgen, or about 520 lb. muriate of potash.

The potash is present largely as chloride, in which form it is excreted in the urine; a certain amount of carbonate is also present in all manure samples. Some Karoo manure, and especially Karoo manure-ash which is even richer in potash, therefore finds its way into standard fertilizer mixtures in order to supply some of the potash constituent. Under present conditions the manure is certainly the cheapest form in which potash can be supplied to the soil.

Chloride (Cl).—As a result of heavy dressings, especially on dryland soils, it has frequently been found that vines, fruit trees and field crops are liable to "burn" as a result of too great a concentration of salts (brak) leached from the manure. For this reason the chloride content of the samples was determined, as this constituent is a useful index to the soluble salt content of the manure. Although the chlorine is present principally as potassium chloride, a number of analyses showed that the sodium content of manures varied between 0·5-7 per cent. Na, with a mean value of 2·57 per cent. Na for 40 samples taken in the southern and western Karoo. There is a strong positive correlation between the Cl and Na content.

If it is assumed that all the sodium is present as chloride, a comparatively light dressing of 5 tons manure per morgen will add at least 400 lb. of common salt (NaCl) to the soil, without taking into account the even larger amount of potassium salts. Unless these salts are well distributed in the soil, there is therefore considerable risk of crop injury, particularly when heavy dressings of 10 to 40 tons per morgen are applied, as is frequently the case for vegetables. Karoo manure should also be used sparingly in areas where the soil is already brackish or where there is a tendency for salts to accumulate as a result of poor drainage conditions.

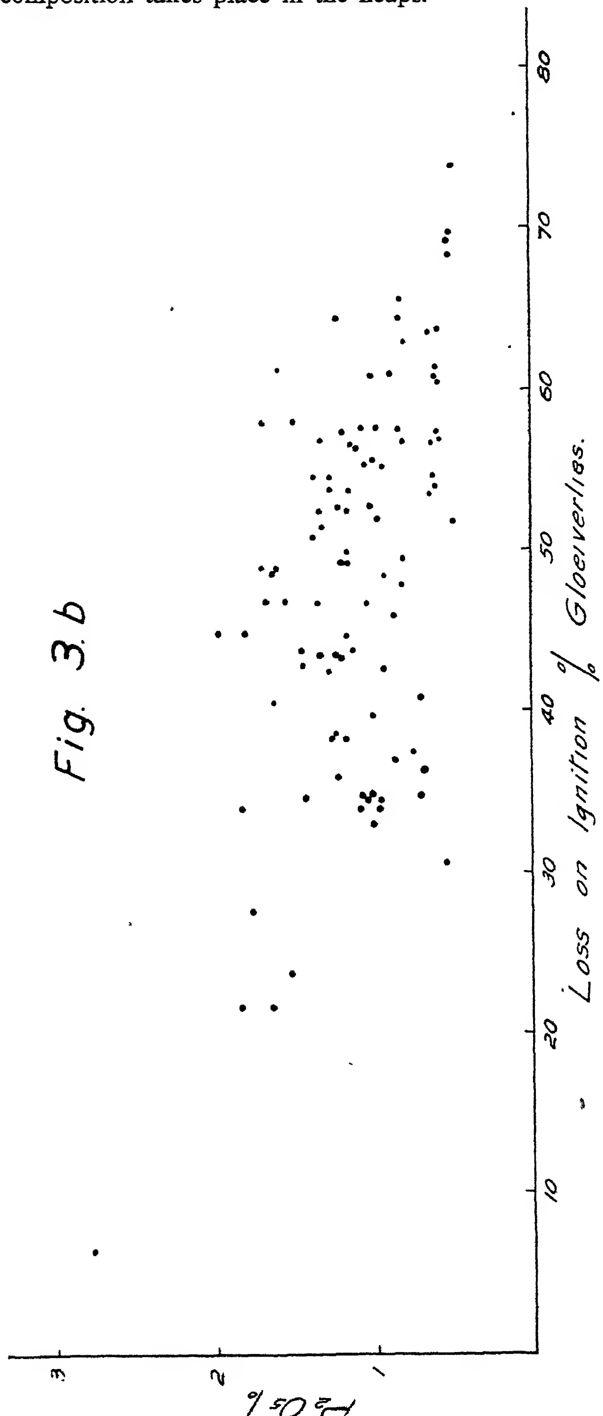
The average pH value of 100 samples taken at random was 9·4, which indicates that a certain amount of alkali carbonate is present. The variation between samples was relatively small and the figures show that Karoo manure is not excessively alkaline, as is commonly supposed.

Relationship between Loss on Ignition, P_2O_5 and N in Manure.

There appears to be a fairly strong positive correlation between loss on ignition and nitrogen content. This is shown graphically in Fig. 3 (*a*) for 100 samples taken from the data at random. On the other hand, the P_2O_5 content decreases with increasing values for loss on ignition, as shown in Fig. 3 (*b*).

It follows from the above that nitrogen and phosphate are negatively correlated. This relationship is also common in bat manures where it was found that, as the manure ages in caves, the nitrogen content decreased, while the phosphate content increased. This is a normal result of weathering, the nitrogen being more easily lost than the phosphate

constituent. In Karoo manure this tendency is not so strongly marked, as little decomposition takes place in the heaps.



(A subsequent article will deal with the value of Karoo manure as a source of plantfood.)

Artificial Insemination in Connection with Stud-breeding in Denmark.

Prof. J. H. W. T. Reimers, Stellenbosch-Elsenburg College of Agriculture, Stellenbosch.

IN Denmark the artificial insemination of dairy cows has now been practised for a number of years as a means of propagating the progeny of good bulls in order to increase the average milk yield of the dairy herds in that country. Bulls whose records prove that they are able to beget progeny with a high milk-producing capacity are selected to be used more extensively for this purpose, since it is possible by artificial insemination to produce a great number of descendants within a few years, thus contributing immensely to the improvement of the milk production in a number of herds.

The following example will explain the benefit of this system. If a bull is used three days a week for the production of semen and produces in these three days 15 c.c. of semen (which is considered to be a very good production for a bull), then this bull, if used for 50 weeks per year, would produce 750 c.c. of semen in a year. Now, in Denmark such semen is diluted fivefold for artificial insemination. Therefore, if 1 c.c. of diluted semen is used per insemination, the total amount of diluted semen would be 3,750 c.c., with which 3,750 cows could be inseminated. Taking a pregnancy percentage of 80 per cent., then 3,000 descendants could be born from one bull in one year. On the other hand, if this bull were to serve the cows naturally, only about 150 cows could be served per year. Again taking the pregnancy percentage as 80 per cent. (often, however, more than one service is needed before a cow becomes pregnant), then the number of progeny of this bull would amount to only 120 a year. In Friesland some bulls have been allowed to serve out of hand more than 200 cows per year, but this is rather a great strain on the bull.

These highly theoretical calculations are, of course, very optimistic, and a production of 5 c.c. of semen every time is rather high, but practical men in Denmark have assured the writer that in practice it is quite possible to obtain 1,000 to 1,500 descendants from one bull in one year by means of artificial insemination. The actual number is generally smaller since not all of the semen produced is used by the farmers' co-operative society owning the bull. The fact remains, however, that the possibility of immensely increasing the progeny of one bull through artificial insemination may have great advantages for the improvement of the cattle production of a country.

Danger of General Application.

Stress must, however, be laid on the increased danger which may also attend the use of a bull of which some bad qualities, quite irrespective of the good qualities, are also propagated manifold in his progeny—qualities which may not only neutralize the advantages gained but even jeopardize all these.

This danger makes it imperative that a bull be used very carefully during the first years of artificial insemination, and not to such an extent as can be theoretically expected, and only to use this bull to the full extent when it has been proved beyond doubt that the inheritance of his good qualities far out-weighs that of his bad qualities.

Before dealing with the practical organization of artificial insemination, it would perhaps be advisable to discuss this matter a little more fully because farmers are often under the erroneous impression that artificial insemination is a cure for all the disappointments encountered in the breeding of animals. Nothing is further from the truth, because the semen, even when minutely examined with regard to the number and normality of the spermatozoa, its vitality and durability, freedom from genital diseases, and anything else that modern science may find, cannot and does not reflect under a microscope the inherent qualities it possesses, and no one can be sure of the ultimate result of this semen in so far as the final outcome of ovulation, viz. the calf, is concerned.

The same trouble encountered by the breeder who uses a bull naturally also confronts the farmer who relies on artificial insemination, but with this difference that the errors to which the breeder is exposed, even with the best knowledge of breeding, are multiplied when a bull is allowed to procreate in one year more progeny by artificial insemination than he would during his whole lifetime when used naturally.

The presence of defects such as inherent poor fertility of the progeny, viciousness of the male progeny, kicking by cows when milked, a tendency to rickets, nutritional abnormalities and various constitutional faults cannot be established before the progeny is mature, and by that time these defects may have been multiplied to such an extent that many herds, and not only one herd, are affected. Consequently, the difficulty of ridding stock of these bad characteristics will also be tremendously increased.

To advise the use of a bull for extensive artificial insemination in many herds is not an easy matter. Before this can be done a thorough knowledge is required not only of the breed to which the bull belongs but of all the different strains, together with all their various characteristics, present in that breed.

As a good breeder will only use a bull fully when he is sure that the animal improves his stock more in some respects than it puts it back in others, a bull used for artificial insemination must be examined even more critically since it is mated to so many different cows of different strains with different tendencies.

Grading up.

The use of bulls for artificial insemination has its greatest advantage in herds in which the quality of the animals is still very low and in which the chances of improving the progeny by the use of an outstanding bull (so far as is known) are very great. If an increase in milk production is the principal objective and the aim of the farmer does not go beyond the breeding of healthy, well-framed utility animals, then the use of such bulls in milk-producing areas cannot be too strongly advocated, particularly where the number of cattle on each of the farms is small and the capital outlay involved in the purchase of a good bull is fairly high. In such cases the joint ownership by a number of farmers of one good bull which could be used in all the herds by practising artificial insemination, can safely be recommended since the system then has great economical advantages.

The System in Practice.

In Denmark many breeding societies possess more than one bull, and each member is at liberty to determine, within reasonable limits, which bull's semen he wants for his particular cows. It is not intended in this article to go into the technical side of artificial insemination since so much is already known, and can also be found in textbooks on the matter. Let it suffice to state that in Denmark artificial insemination is

practised by allowing the bull, after being prepared, to serve a cow specially kept for this purpose. The semen is caught in the artificial vagina, and, after careful examination under the microscope, is diluted to a fivefold volume with gelatine and egg yolk. Specially designed tubes are then filled and cooled and marked with sealing wax of different colours, so that these can later be sent away to the various farmers requiring the semen, or taken away by the person responsible for the carrying out of the insemination. The sending or the transport of these tubes to the farmers is done in specially designed thermoflasks, and with the use of an ingenious instrument the gelatine-semen is introduced into the womb of the cow when on heat.

Semen older than 48 hours is hardly ever used, and experience has shown that during the first 48 hours the semen does not deteriorate appreciably if kept in the flasks. Cleanliness in carrying out the insemination is scrupulously observed and the results obtained are considerd to be the same as those with normal service, sometimes even better on account of the accurate examination of the semen before use.

Control as a Safeguard.

The practice of artifical insemination is not State-controlled but can rather be described as a co-operatively controlled undertaking either by co-operative breeders' organizations or by the stud breeders in that stud cattle are artificially inseminated under the control of specially appointed persons. Both systems, i.e. the artificial insemination of both non-stud-book cattle and stud-book cattle, are fundamentally the same.

Organization of the Scheme.

If, for instance, a farmers' co-operative society decides to practise artificial insemination in the herds of its members, it begins by purchasing a few bulls, preferably such as have already proved through their progeny they are good breeders for milk production and butterfat and that they breed animals with good constitution and conformation. These animals are stationed at a centrally situated point on the farm of one of the members who is paid for their upkeep from the funds of the organization. A service stable is constructed and also a small laboratory for the examination and further preparation of the semen. A specially trained person, either a veterinary surgeon or a layman with a thorough knowledge of animal husbandry and training in this work, is appointed and paid per animal treated. As a trained person can artificially inseminate at least 3,000 cows per year, and the payment per animal is 6 kronen (equivalent to 6 shillings) for his services, with the price of the semen at 30 to 50 kronen (about £1. 10s.-£2. 10s.) per dose, this person and the society receive a very good income from this type of work. The official conducting the artificial insemination is paid by the society in whose employment he is.

When an insemination is carried out, a book of forms is used in which is entered in duplicate the name of the bull from whom semen has been taken, the date of insemination and the name or number of the inseminated cow, one-half of the form being kept by the owner of the cow, and the other half filed in the office of the association. The semen of different bulls is distinguishable by the colour of the sealing wax used for closing the tubes containing the semen. This simple control works very well, provided the farmer resorting to artificial insemination does not at the same time keep a bull himself, but this is hardly ever done owing to the high prices of bulls and the cost of their upkeep. It is much cheaper for a farmer to spend between £15-£30. (where two inseminations have to be done, the costs are, of course, double) to have ten cows inseminated by a good bull than to buy and keep a good bull himself.

As most Danish farmers possess between 8 and 20 dairy cows, a very considerable saving is effected through the practice of artificial insemination under expert application and advice. In Denmark most farmers are connected by phone to the central station and can therefore quickly obtain the necessary doses of semen. The person in charge of the work then does his daily round by car so that the cows are usually inseminated the same day. This procedure is, however, only practicable in countries with a dense farming population where distances are of no account. One of the stations visited by the author had six to seven bulls in regular use and employed three veterinarians. In addition to the older bulls, some young ones were also tried out. The purchase of these bulls is done by the council of the society ably assisted by the animal husbandry consulting expert who is not a Government officer but an employee of the agricultural society.

When herd-book cows are artificially inseminated, the procedure is the same, but with this difference that the service forms are made out in triplicate, one being kept by the owner of the cow, one filed in the office of the insemination station and one sent for registration in the herd-book.

As Denmark is a country in which semen can be sent either by plane, post or lorry to nearly all parts within 24 hours, and at the most within 36 hours, and as well-prepared semen will remain effective for at least 48 hours, a central station, Kolle-Kolle, has been erected by a semi-private company in one of the suburbs of Copenhagen where a special veterinary surgeon is employed for its work. After collection and a quick preliminary examination at the station, the semen is rushed to the laboratory of the veterinarian, finally examined, prepared and sent off without delay to the applicants whose applications have come in during the previous day or the same morning. The writer witnessed the collection of semen at 5 a.m., and at 9 a.m. saw all the semen being sent off to the various destinations, most of which were reached that same afternoon. There it is fetched directly from the station by the person in charge of the artificial insemination in the area concerned. As soon as the insemination is carried out, the necessary papers are filled in and signed, one being retained by the owner of the cow(s), one sent back to the station and one submitted for entry in the herd-book.

Introduction of Artificial Insemination in South Africa.

In view of the possibility of fraudulent practices by unscrupulous breeders and on account of the possibility of introducing artificial insemination into our country, the writer regards it as incumbent upon him to discuss the pros and cons of the scheme a little more fully. It should be noted that in Denmark this scheme is a great success owing to the following factors.

(1) Denmark is a small, densely populated agricultural country in which distances are so small that the use of fresh semen presents no difficulties in so far as transport is concerned.

(2) Denmark has an excellent system of telephone, telegraph, railway, bus and aeroplane communications which facilitates the ordering of semen at the right time, the despatch of semen at short intervals, and the application of the insemination in the shortest possible time.

(3) In Denmark there are co-operative breeding societies scattered throughout the country with ample facilities for testing the milk production of animals.

(4) In such a densely populated country as Denmark it is comparatively easy to guard against fraud, and the use and activities of a bull on a farm where artificial insemination is also applied can readily be controlled.

(5) On account of the strong membership of the various co-operative societies, these societies can afford the cost of appointing a specially trained person to carry out the work of insemination. This person is a full-time employee of, and is paid by, the society. Any fraudulent act on his part would be followed by instant dismissal as officer of the society and the farmer who allowed or connived at fraudulent practices would also have punishment meted out to him. It is, of course, still possible for a breeder to commit fraud by serving his cow with his own bull after the cow has been artificially inseminated, but such an act would be gross stupidity. If a farmer serves his cow with his own bull later on when the cow comes into heat again, this would readily be detected when the calf is born because the time of its birth would not correspond with the date calculated from the artificial insemination, with the result that the breeder would be exposed to grave suspicion from the side of the herd-book officials.

In Denmark cases of fraud or cases giving rise to suspicion are, the writer was assured, very rare on account of the efficiency of the system and the mutual control exercised, as well as on account of the employment of persons whose status, study and education do not make them inclined to participate in such nefarious practices.

A comparison between South Africa and Denmark will, however, quickly show what (except in certain circumstances) almost insurmountable difficulties present themselves in our country in regard to the artificial insemination of cattle.

(1) South Africa is a very large country with a small population on the land where extensive farming is practised on big properties which often have enough cattle to be able to keep one bull to serve the stock. At the same time it has long distances which make the possibility of the use of semen at the right time very problematical.

(2) Rail, bus and other communications in South Africa are less frequent and even telegraphic or telephonic communications take so much time that the ordering of semen at the right time, as well as the despatch and application of such semen within the prescribed limit, is extremely difficult.

(3) Facilities for testing the progeny of bulls used for artificial insemination are almost non-existent.

(4) Control amongst breeders or farmers can easily be evaded.

(5) Farmers' co-operative societies embracing also the breeding of animals and the co-operative ownership of bulls are not known in our country. It is therefore impossible to appoint a full-time officer to take the matter in hand and to carry out the insemination if the Government does not lend a helping hand.

All these obstacles can perhaps be overcome in the future, but as the position it as present only a very limited use can be made of this otherwise excellent system, which already works so well in Denmark, and which also promises to be a great success in certain areas of Holland and England.

In our country the application of the system would be restricted to areas in which the farms are small, keep only a limited number of cattle and are so near each other that in a circle with a radius of 15-20 miles enough animals can be found to make artificial insemination worthwhile.

Applied mainly to grade cattle, for which purpose it is ideally suited, the system can be practised in dairy herds around the larger towns, in the wine and fruit-growing areas, and in certain grain-producing areas in which the dairy-cattle industry will extend considerably in the years to come if put under the supervision of a specially appointed officer either of the State or, better still, of a farmers' co-operative society specially established for that purpose.

[*Continued on page* 288.

The Harvester Termite.

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THE termite species belonging to the genera *Hodotermes* Hagen, and *Microhodotermes* Sjöstedt, are found distributed throughout South Africa, from the Cape Flats of the western Cape Province to the Zambesi River, and from there extend northwards through the Sudan to the shores of the Mediterranean. Sjöstedt (1925) lists 19 described species, subspecies and forms from Africa, of which no less than 16 are indigenous to the Union of South Africa and the mandated territory of South-West Africa. The optimum conditions for the survival and increase of the species appear to be found in areas with a low annual rainfall, and they are in consequence probably nowhere more at home than in the widespread arid stretches of Southern Africa.

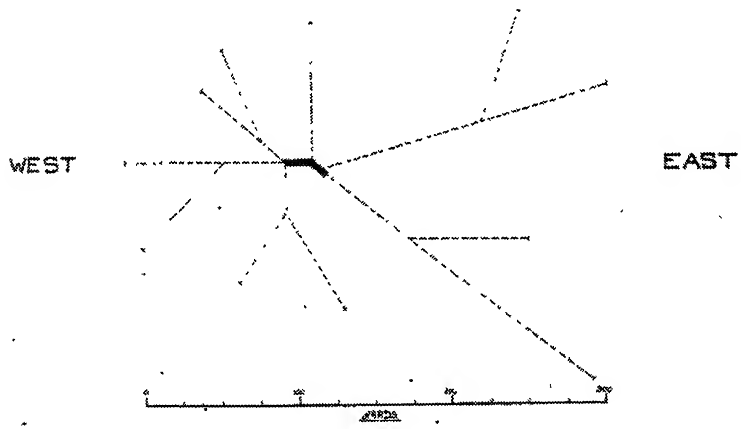

FIG. 1.—Plan of the nest system of the Harvester Termite colony excavated at Franckenwald as evidenced by the soil dumps. The portion dug up, and portrayed in Fig. 2, is blacked in heavily.

Though the various species differ somewhat in size, proportions and colour, there is no appreciable divergence in their nesting and feeding habits. In the Union they are all grouped together under such popular names as Foragers, Harvesters, "Houtkappers", "Stokkiesdraers", "Knipmiere" or "Grasdraers"—names derived from the habit common to the species of cutting grass and twigs into short lengths, which are carried or dragged on the surface to holes in the ground, whence the food supplies are conveyed through passages in the soil to the subterranean nest hives.

The Harvesters do not attack timber, the type of damage most commonly associated with termites, but they are nevertheless of great economic importance in the Union. The townsman knows them well as a result of their denudation of lawns and stripping of hedges, shrubs and plants in gardens. Their habit of burrowing through and undermining walls constructed of raw-brick, of destroying thatched roofs, wall-paper, cotton materials, books and other materials of a similar type containing cellulose, also frequently brings them into the public eye. It is, however, in agricultural and pastoral areas where they play their major economic rôle. Firstly, they bring about widespread denudation

of grass and bush needed as grazing for livestock; apart from the considerable lowering of the carrying capacity of such veld, the removal of the grass cover decreases normal reseeding and results in soil desiccation and erosion. Secondly, the Harvesters annually destroy or seriously decrease the yield from large areas under wheat, beans, lucerne, teff and oats in many parts of the Union.

To discover satisfactory and economically practical control measures for use against the Harvesters has been one of the main termite research projects of the Division of Entomology over the past 10 years. This involved a detailed study of the nesting and feeding habits of the species about which little was known. Thereafter small scale control tests were carried out in Pretoria and its environs, and these were followed by field-scale control experiments in the Orange Free State to determine the practicability and costs of the methods evolved. Some of the results of this research are given below and are condensed from a bulletin on the subject shortly to be published by the Department.

The Nest System.

In March 1937, the writer traced out in detail a portion of the nest system of a colony of H. *mossambicus* sub. sp. *transvaalensis* Fuller, which inhabited a grassy slope at Franckenwald, the experimental farm near Johannesburg of the University of the Witwatersrand. Below a surface layer of soil approximately 3 feet deep, lay a hard stratum of "ouklip" (iron sesquioxide) which in turn overlay "potklei" (decomposed granite). It was expected that the nest hives would be found in the upper soil layer, so that a minimum of digging would be required to locate them. In areas where the soil layer is deep, the hives may be placed at considerable depths. In one suburb in Pretoria, where the surface layer is of sandy loam about 10 feet deep, a hive accidentally encountered while a well shaft was being sunk, was observed at a depth of 7 feet below the surface. In the Witwatersrand Deep area where the soil layer is very deep, the hives of an excavated colony were placed from 10 to 20 feet below the surface. It was mainly on account of the shallow surface layer of soil that Franckenwald was selected as the site for excavation.

A series of sketches (to scale showing the courses of the passages being followed up was made as digging proceeded, and these were subsequently combined in one comprehensive semi-diagrammatic sketch (Fig. 1). Owing to the laborious and slow nature of the work, the large area occupied by the colony and the shortage of time, only the 17 yard length of central workings was originally traced out. The hives encountered from west to east are numbered from 1 to 7 in the sketch, the soil dumps D. 1 to D. 8, and the harvesting holes are marked H. Subsequently a further 10 yards were dug up and in this distance a further two hives were found. All nine hives were proved to be inter-connected and part of the same nest system. The size of the excavated strip in relation to the total area occupied by the colony can be clearly seen in Fig. 2 where the area excavated is blacked in heavily. The results of excavation along the south-eastern line are not portrayed in Fig. 1.

The subterranean passages leading from the surface dumps to the hives descended fairly steeply in a series of steps, remaining about the thickness of a man's little finger until about a foot from the hives when they widened out considerably. In Fig. 1, the routes followed by these passages are considerably more shortened and simplified than they were in reality. Numbers of additional branching passages connected up with those in the sketch are omitted. Only by means of a three-dimensional model it would be possible to reproduce accurately the whole labyrinth of twisting, branching passages uncovered by the excavation.

Although all nine hives exposed at Franckenwald were built on the same basic pattern, they could be divided into two distinct classes. The soil surrounding hives 1, 2 and 3 contained a large number of flattened, inter-connected cavities, the floors of which had been blackened by faecal deposits. In these were stored additional supplies of grass to supplement that crammed into the shelving of the hives themselves. This additional storage space was lacking in the soil surrounding hives 4 to 9. From the insects observed in the hives it was quite clear that numbers 1 to 3 formed the breeding centre and hub of the colony. From them were taken 23 male and 36 female functioning second-form reproductives. These hives contained, in addition, numerous eggs and callows in all stages of development plus the normal complement of adult soldiers and workers. Hives 4 to 9 contained no functioning reproductives and were inhabited only by adult soldiers and workers plus a sprinkling of advanced nymphal forms of these castes. These hives obviously served as granaries only.

It would appear that when the growing population density of a colony demands increasing food supplies, or when the grass available on the surface decreases with droughts or grazing, the termites drive subterranean passages further and further away from the hub of the colony in search of new supplies. Along these lines of expansion new hives are constructed for temporary storage of the food supplies gleaned on the surface and to house the foraging parties. From these depots supplies are

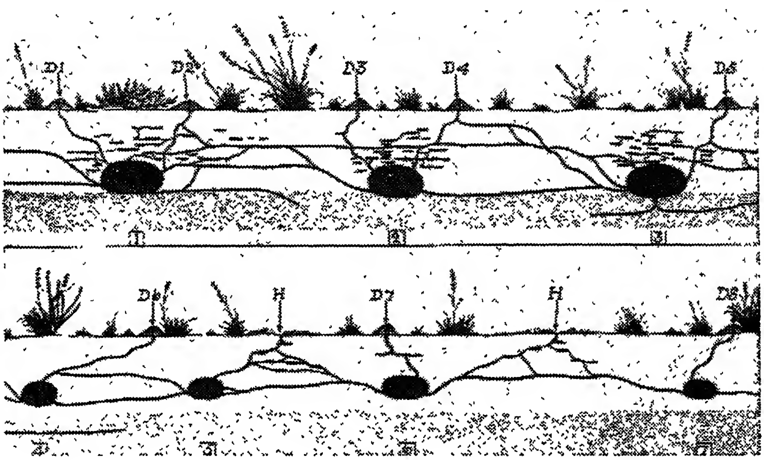

FIG. 2.—Semi-diagrammatic sketch of part of the nest system of a Harvester Termite colony at Franckenwald. Nests 1-3 are breeding hives, while 4-7 are supplementary hives. Soil dumps and harvesting holes are labelled D and H respectively.

conveyed underground to the nurseries as required. If this theory is to hold water, the converse must hold, i.e. when rains have fallen and grass becomes available near the hub of the colony—the furthest supplementary hives should become redundant and be voluntarily deserted by their inhabitants. This alternate expansion and shrinkage in the area covered in foraging by Harvester colonies, has by observation been established beyond any reasonable doubt by the writer at Schaapplaats. This aspect will be dealt with later.

From the harvesting holes, narrow passages led to a series of flattened inter-connected chambers usually with a floor diameter of approximately 3 inches. These pockets lay at depths of from one inch to a foot below the surface. Although in Fig 1 passages from hives to harvesting holes show only in the case of hives 5, 6 and 7, these were present with all the

remaining hives as well. It was not possible to portray them in this two-dimensional sketch. The chambers below the harvesting holes are used for the temporary storage of grass supplies while foraging is in progress. Subsequently, these supplies are transferred either to the nursery or the supplementary hives.

The Inhabitants of a Colony.

Only two Harvester castes are normally encountered above soil level, viz., the workers and the winged reproductives.

The workers [Plate I (D)] are always heavily chitinised and dark in colour—brown in the southern Cape Province, and dark brown to black elsewhere. They forage in the open by day or by night and are well known to most people in the Union. Occasionally, especially in very juvenile colonies where there is a shortage of adult workers, unpigmented nymphal forms of the worker caste which are sufficiently developed to forage may be observed joining in the harvesting activity.

The winged reproductive forms are seen above the surface for only brief spells in the summer months after rains when swarming flights are in progress. Like the workers, the winged forms are dark-bodied [Plate I (C)]. Atfer a brief flight, males and females pair off, shed their wings and burrow into the soil, there to found the new colonies of which they will be kings and queens.

The males and females which have founded new colonies, always carry on their thoraces the stubs to which their wings were originally attached. These are known as first-form reproductives. The male does not increase to any extent in size, but the abdomen of the female becomes grossly distended due to the development or her ovaries [Plate I (A)]. The royal pair are not sealed up in a cell but move at will within the confines of the nest system.

Should the founders of a colony die of old age or be destroyed by enemies, the workers may substitute for them one or more pairs of the winged reproductives should these be present in the colony. The wings are removed and these pairs commence reproduction without undergoing the swarming flight. In such cases one or more pairs of first-form reproductives may be present in the breeding hives. Failing adult winged individuals, nymphal forms of this caste may be directly converted into functioning reproductives [Plate I (B)]. These are known as second-form reproductives—they are white, unchitinised and carry on their thoraces the buds which under normal conditions would have developed into wings.

In the nest system excavated at Franckenwald, 59 second-form reproductives were taken from hives 1, 2 and 3. Evidently the first-form queen and king which had founded the colony had died and their sexual function had been assumed by numbers of their nymphal reproductive offspring before these had developed fully formed wings. In another locality at Franckenwald a hive was accidentally uncovered when a pit was being dug, and in it the fully developed first-form queen portrayed in Plate I (A), was discovered.

The soldier caste can usually be found just below soil surface in the passages leading from dumps and harvesting holes. Soldiers are also present in large numbers in the nest hives. They have white abdomens, yellow to orange-coloured heads with massive-toothed black manibles. [Plate I (E)].

Apart from these adult castes, all breeding hives contain nymphal forms of the soldier, winged reproductive and worker castes in various stages of development.

Harvesters and their Destruction of Grazing.

During 1937 and 1938 it was established that there is a distinct expansion in the area covered by each Harvester colony during foraging as surface grass supplies decrease. When rains have restored available grass supplies, there is a corresponding decrease in the area covered in foraging. This seasonal expansion and contraction in surface activity was established by detailed quantitative surveys of the vegetation present on the surface over an isolated Harvester colony at Schaapplaats.

During May 1937, when grass was in good supply, the badly denuded patch over the nest system of the colony totalled 25 square yards in area and supported 294 active harvesting hills. By September 1937, an area 3,600 square yards in extent, did not contain all the workings of the colony and the central denuded patch had increased to 491 square yards. At this time more than 552 harvesting holes were counted on or adjacent to the central bare area. After summer rains had restored the vegetation, the same area was resurveyed during May, 1938. All the distant harvesting holes observed during the previous September had been abandoned, and the central denuded patch had shrunk to its May 1937 level—it now covered 28 square yards, on and adjacent to which 193 harvesting holes were counted.

In the case of the colony, the harvesting activity of which is recorded above, there was no competition for available food supplies from neighbouring colonies. Over the greater portion of Schaapplaats, however, the colonies were so closely placed to one another, that just after midwinter the denudation brought about by one colony merged with that caused by its neighbours, and the whole veld appeared to be covered with large bare patches separated from one another by narrow strips and patches of semi-denuded grass. In July 1938 the writer surveyed an area where such conditions prevailed and counted on eight plots with an aggregate area of five morgen all the active harvesting holes. For the individual plots these totalled 8,076, 7,781, 7,166, 9,592, 8,944, 6,851, 7,938, and 6,610 respectively, an aggregate for the five morgen of 63,058 harvesting holes and an average per square yard of 1·26.

These figures serve to show how uniformly and heavily the area surveyed was infested by Harvesters. There can be no doubt as to the important rôle played by these insects in bringing about the complete denudation of grass cover prevailing in many parts of the Orange Free State and Transvaal at the end of winter and in early spring. With the veld as denuded as it was in July, 1938, more and more foraging tunnels were being driven progressively further afield from the central breeding hives of each of the large number of colonies. Even sheep dung was being cut into bits and dragged underground to supplement the meagre grass supplies obtainable from the veld. String, used by the writer to demarcate survey strips, had to be continuously replaced as it was being cut to bits while counts were being taken.

With such conditions prevailing in July, should the spring and summer rains be delayed, the competition for food between individual colonies becomes even more intensified and complete removal of the stand of grass results. The outcome of a saturated Harvester population on grazing land during years of summer drought is the complete removal of the grass cover strikingly shown by Naude (1934) by means of a photograph taken at Appel siding in the Orange Free State.

In any normal year letters which report the havoc caused to grazing by Harvesters pour into the offices of the Division of Entomology. Very few such letters are received during the summer, autumn and early

winter months in normal years when there is a good stand of grass on the veld as a result of good rainfall. Under such conditions the activities of the insects are masked by the vegetal cover, and the shrinkage in the area covered by individual colonies has taken place. The flood of correspondence usually starts during midwinter and reaches a crescendo in spring and early summer if the rains are delayed. By this time expansion in the areas worked by the colonies is reaching the peak level and due to heavy denudation and daily harvesting, the activities of the insects are apparent even to the casual observer. This has led to the general impression that droughts favour the increase of Harvester populations. Drought does not increase the populations—it merely makes apparent what is happening on grazing veld every year, dry or wet, over vast areas of the Union. The absence of rain prevents the normal regrowth of vegetation which would effectively mask the activities of the Harvesters before complete denudation has been attained. Drought merely emphasizes the normal rôle played annually by Harvesters in veld destruction.

To attempt to eradicate Harvesters in infested veld in late winter and during summer droughts is in most cases an impossible task, since by this time foraging activity has spread to such an extent that whole farms will have to be uniformly covered with bait at a time when all available supplies of hay and chaff have to be fed to the animals to keep them alive, and none can be spared for the huge quantities of bait required. The best control procedure would be to mow grass and convert it into bait in late summer when Harvester activity is least apparent and grass is most plentiful. The baiting should be done just before midwinter when the areas covered in foraging by the colonies are comparatively small and the late seasonal expansion has not yet started in earnest. In this way bait supplies will be conserved. At the same time, in midwinter harvesting takes place in the hours of daylight, and infested areas can most easily be spotted. There is at this time also only a very small risk that bait will have its poison content diluted by rain after it has been applied and before the Harvesters have had access to it.

Bait Production and Costs of Treatment.

In preparing bait it must always be borne in mind that sodium arsenite is both a stomach and a contact poison. Under no circumstances should stock have access to the solutions or bulk supplies of prepared bait. The area within which the bait is prepared and dried should thus be adequately fenced in. The labourers doing the mixing should take every precaution to prevent the solution from contacting the skin. The hands should be well greased with vaseline before mixing commences, and the bait itself should not be handled until thoroughly dry.

For preparation of bait in bulk it is convenient to site the mixing ground adjacent to a hay stack. At the base of the latter by means of a chaffing machine, the grass is cut into half-inch lengths. Adjacent to the heap of chaffed grass are placed open 44 gallon drums containing the poison solution prepared in the proportion of 1 lb. of sodium arsenite to eight gallons of water. By means of a wicker bushel basket, chaffed grass is dipped into the solution and forced below the surface by prodding it with a circular board with a suitable long handle attached. As soon as the grass has been wetted, the basket is raised and held over the drum to allow the excess solution to drain off. The basket is then inverted by foot on a tarpaulin where the wet bait is allowed to dry, and the process is repeated. The wet bait is raked over from time to

time until thoroughly dry, when it can be safely handled and bagged for use or storage. Since drying takes time, provision must be made for adequate space for drying in the fenced area. Prepared bait can be

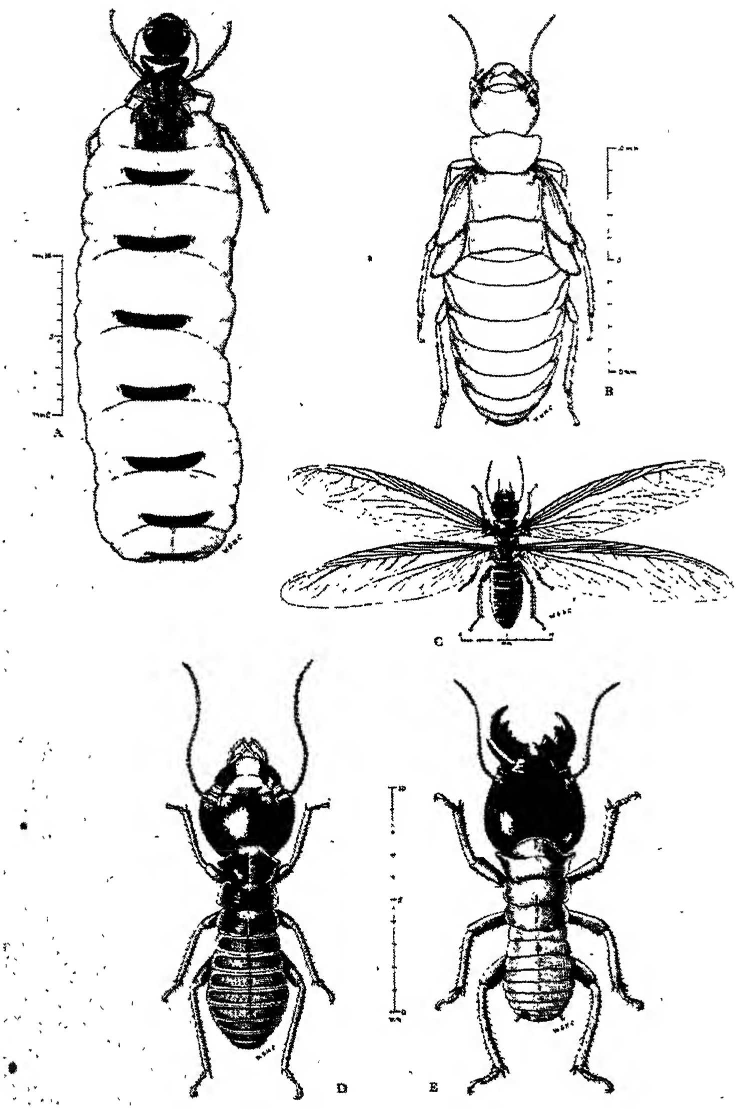

PLATE I.—Typical inhabitants of the nest system of *Hodotermes mossambicus* sub. sp. *transvaalensis* Fuller. (A) The first-form queen, (B) The second-form queen, (C) The winged reproductive, (D) The worker, (E) The soldier.

stored indefinitely, but should always be kept under lock and key. The bait is broadcast by hand over infested areas at a dosage of 4 muid bags per morgen. One application only is required.

Bait preparation, including labour and sodium arsenite supplies, averages out at 1s. 1·8d. per morgen. Costs of labour for spreading the bait averages out at 1·1d. per morgen. The total cost per morgen for large-scale Harvester eradication thus averages out at approximately 1s. 3d., excluding only the cost of mowing the grass supplies needed for bait. On farms where wheat is grown, chaff can be substituted for veld grass as carrier for the sodium arsenite.

General Observations.

Farmers' Associations from many areas where Harvester infestation has assumed serious proportions, have for some time requested the Government to regard the eradication of these insects as a problem to be tackled on a national basis, as is done in the case of the locust, and to provide prepared bait at cost price to farmers. Although these requests have been very sympathetically received, the difficulties involved in adopting such a policy are wellnigh insuperable. Chaffed grass is light and extremely bulky. At a dosage of four muid bags per morgen it will be realised how great would be the bulk of bait required to treat the vast areas involved in all four provinces of the Union. Apart from collecting at centralised depots the enormous quantities of grass required, transportation of the bulky prepared bait to where it is needed, would be a virtually impossible task with such large areas involved. Bait production cannot be centralised. To overcome transportation difficulties, the only solution would be for the individual farmer to prepare his own supplies near the site of application.

Other farmers' Associations have requested that the Department of Agriculture make available to them supplies of prepared arsenical locust bait for use against Harvesters. This bait consists of finely ground maize bran treated with sodium arsenite. Its transportation would offer no serious difficulties, and ample redundant stocks are available. Unfortunately the bran particles are too fine to be of much use against the Harvesters which do not feed on the surface, but transport their food to the underground nest system before consuming it. Experience has shown that these insects will take the larger, more easily and speedily collected grass pieces in preference to fine bran. There can be little hope of attaining satisfactory Harvester control if bran is used as carrier for the poison. The locust bait is thus totally unsuitable for use against these insects.

Recently considerable publicity was given to the suggestion that for eradicating Harvesters over vast acreages of uniformly infested veld, the bait should be spread by aircraft. It was suggested that by this method there would be a considerable saving in time and labour. The Division of Entomology has been closely associated with the use of aircraft in insect control for well over 20 years, and the possibility of using this means of bait application in Harvester control was carefully considered and rejected some years ago.

One difficulty involved in the use of aircraft for bait distribution lies in the fact that chaffed grass clogs and will not flow evenly and freely out of the hopper. In addition then to patchy bait distribution, the speed of bait emission from the hopper in relation to the speed of the aricraft is so slow that it would be impossible to attain the required dosage of four muid bags of bait per morgen in any one run.

Assuming that this difficulty could be overcome, for so light a material as chaffed grass, the aircraft could carry only a limited volume of bait per load—using a light plane as was suggested, one load would

be sufficient to treat only half a morgen. Allowing a generous estimate of 10 minutes per trip, to treat 500 morgen, one aircraft would be required to make 1,000 trips involving 166 hours of continuous operation or approximately 16 ten-hour working days. Even under the difficult conditions prevailing in the Transvaal Bushveld, 12 labourers could handbait the same area in just over 9 ten-hour working days at a total cost of £31. 5s. in labour and materials. Assuming that the cost of operating a light plane amounts to 15s. per morgen, and the bait costs 1s. 1·8d. per morgen to prepare, it would cost approximately £403. 15s. to treat the same area by aircraft. If larger aircraft capable of carrying greater loads are used, these would have to operate from aerodromes thus increasing the dead flying time, and hence, expenses are hardly likely to be reduced. The use of aircraft for large-scale bait distribution is thus both impractical and uneconomic.

Recommendations.

(i) Harvester bait should consist of grass chaffed into half-inch lengths, dipped in a solution of 1 lb. of sodium arsenite to eight gallons of water and dried before use. The method of preparation should be as described above. Where grazing of camps during or shortly after treatment cannot be avoided, sodium fluosilicate should be substituted for sodium arsenite in the solution.

(ii) The bait should be prepared in late summer when grass is most plentiful and Harvester activity least apparent. It should be applied towards midwinter in infested veld when the seasonal increase in the area covered in foraging is becoming apparent and the Harvesters are active by day and clearly visible.

(iii) In cultivated lands the bait should be applied just before or during sowing, or shortly after the grain has sprouted.

(iv) The bait should be evenly spread over infested areas at a dosage of four muid bags per morgen. Only one application at a cost 1s. 3d. per morgan should be necessary.

(v) Camps treated with arsenical bait during the winter should be reserved for summer grazing after rains have fallen. If numbers of camps on one farm have to be treated, this should be done in sections over a period of years so that by controlled grazing, no stock is introduced on to treated areas till summer rains have fallen. Where such veld management is not possible, sodium fluosilicate bait should be used.

(vi) Infestations in buildings can be eradicated by regular systematic bait applications around the buildings whenever and wherever the insects are seen foraging. Treatment may have to be continued over a period of several months before the indoor infestations are completely eradicated.

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The Mole Trouble.

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MOST suburban dwellers and those living on the outskirts of towns or cities, as well as market gardeners and farmers, have experienced trouble with moles in their gardens and lands. The annoyance caused by these small animals making their surface runways and throwing up mounds in lawns and seed-beds, and the destruction caused to root crops by the larger mole-rats, are too evident to escape the notice of even the most casual observer.

All conditions of soil, ranging from dry and sandy to a very moist, and from soft to very hard and stony ground, appear to be congenial to these little subterranean creatures.

Two Groups of Moles.

The term "mole" is applied to members of two quite different groups of animals.

The golden mole, also called the surface mole or "Kruipmol", belongs to the family *Chrysochloridæ*, and the mole-rat to the family *Bathyergidæ*. The habits of the two in burrowing in the ground are rather similar, but in other respects they differ markedly. In the first place, the golden mole is insectivorous, and in this respect is beneficial, while the mole-rat is a root-eating rodent, and is generally destructive.

The Golden Mole.

The Albany Museum Guide to the Vertebrate Fauna of the eastern Cape Province (1931) describes the Golden-moles (Chrysochloridae) as being represented by five species, and states that these have no near allies so far as is known.

Most of these moles are about 4½ inches in length, and their fur, generally of a golden colour, has a lovely velvety sheen. There is a more rare species of a glossy black colour. These little animals are beautiful and sleek in appearance. The eyes, which are very small, are hidden in the skin, and the ears are just apertures encircled by hair. The teeth are small and are not seen when the mouth is closed, and the snout is of medium length. The limbs are very short, the feet bearing strong claws for burrowing. The tail is so short as to be practically non-existent.

These moles have main runways deeper underground, but burrow chiefly just under the surface of the soil in search of caterpillars and other insects, and from this habit arises their common name of surface mole or "kruipmol". They often cause much annoyance to owners of lawns by raising the grass wherever they burrow, as well as throwing up the characteristic mounds. They apparently have a great liking for seed-beds, and frequently burrow right along rows of seeds and seedlings, raising up the earth so that it dries out quickly and, as a result, the young plants soon wither and die. These moles undoubtedly destroy much insect life in the ground, but unfortunately this benefit is sometimes more than counterbalanced by the annoyance and inconvenience they cause, to the extent of becoming a real nuisance.

Control.—One method of destroying the "kruipmol" is by means of a specially made spring trap. This consists of two long prongs which are pushed into the ground, one on either side of a runway, and a small metal plate that fits flat on the ground, and which, when raised by the mole passing under it, releases a strong spring that drives two sets of spikes into the ground and impales the mole. The trap should be set over a runway which, by treading down once or twice, is seen to be used again and acts as a main thoroughfare, as for instance through a pathway.

Lawns can be cleared of the surface mole by applying arsenate of lead powder mixed thoroughly with the top dressing or with fine soil for ease of application and even distribution. The poison may also be mixed with water and applied by a watering-can. It is used at the rate of one ounce per square yard, and subsequent watering takes the poison into the top layer of soil where it remains effective for a year or two, provided heavy floodings of the lawn are not frequent. This treatment also destroys most insect pests of lawns such as white grubs.

Cats will sometimes scratch out these moles as they are burrowing along near the surface of the ground and kill them, but seldom, if ever, eat them.

The Rodent Mole or Mole-Rat.

The rodent mole or mole-rat, family *Bathyergidæ,* apparently consists of two principal species in South Africa, viz., *Cryptomys* and *Georychus,* which are very similar in their habits and characteristics.

The mole-rats may attain a length of about 9 inches, but on an average are from 5½ to 7 inches long. The fur is soft and thick, and the general colour is from buff to a dirty-brown above, shading off to a grey beneath, with or without white markings on the head. Mole-rats have large upper and lower curved incisor teeth which protrude prominently, and give the creatures a fierce appearance. Their legs are short, with small claws to both fore and hind feet, and a short thick tail.

The tunnels or burrows of the mole-rat are usually 2½ to 3 inches in diameter and a foot or more underground. The animal burrows nearer the surface from its main tunnel when in search of food, or when, in burrowing into new ground, it is necessary to bring the excavated soil to the surface. This soil is then thrown into mounds.

The food of this rodent consists of a large variety of roots and tubers, and it is particularly fond of garden crops such as potatoes, sweet potatoes, carrots, parsnips, onions, the roots of parsley, lettuce, carnations, and many flower bulbs. This food is stored in specially made "chambers" off the main burrow, usually two feet or more below ground, and in this way the mole secures a good supply for future use. One mole-rat may therefore be responsible for the disappearance of a large quantity of garden produce.

Methods of Control.

A sure way of destroying the mole-rat is by shooting. The burrow is opened, preferably at a fresh mound, and the creature will invariably appear at the opening within a few minutes if there is no noise. It can then be shot quite easily with a 0·22 rifle, but one has to have the rifle ready, as the least movement or noise will cause the rodent to disappear immediately. The writer has killed many mole-rats in this manner, and found that the best method of waiting for them is to lie flat on the ground with the muzzle of the rifle only a few inches from the burrow entrance and pointing directly into it. As soon as the mole-rat appears it is simply a matter of firing without any preliminary movement. Mole-rats appear clumsy on the surface of the ground, but move very quickly in their burrows. Some people wait until the animal is ejecting soil and then shoot into the mound, but it is easy to miss the mole-rat this way and, once scared, these little creatures are very cautious afterwards.

Digging out mole-rats is not difficult if one has patience. The upper layer of soil above a burrow which runs horizontally should be sliced off with a spade so as to leave a thickness of two or three inches of earth for eighteen inches from the opening. Stand ready and perfectly still, and when the soil is being pushed out at the opening of the burrow, quickly jab in the spade behind the mole and throw it out into the open.

The small steel trap or " slagyster ", with jaws about two inches wide when open, is very useful and effective for catching mole-rats. It is set without bait and placed about a foot into a burrow in a slight depression made by hand, so that the trap lies level with the bottom of the tunnel. The entrance is then closed with a sod of earth. The trap should always have attached to it a piece of stout string which is tied to a stake outside the burrow. If a slack is left in the string, the tightening of this will indicate when the mole-rat is caught. There are other types of mole traps, and their success or failure largely depends upon the technique in setting and placing them.

Poisoning is another method of control frequently employed. A wedge-shaped piece is cut out of a potato or carrot, a smear of strychnine put in, and the piece re-inserted. The bait is then placed well into the burrow, and the opening closed up tightly with a plug of grass and damp earth. The bait should be touched as little as possible by hand, and care taken that it is not thrown out of the burrow with the mound of soil, as sometimes happens.

Additional Measures.

Moles and mole-rats may be controlled by pumping one of the cyanide powders, such as " Cyanogas " or " Calcid ", into the main burrows. A special pump, however, is required for this purpose, such as those used for rodent destruction. The moisture in the ground causes hydrocyanic acid gas to be liberated from the powder blown into the burrows, and this gas, as soon as it is inhaled, causes certain death to these little underground animals. The use of a hydrocyanic acid gas fumigant is almost essential to combat the mole-rat problem in old neglected lands and in virgin soil where these creatures have become numerous.

Some years ago, before the cyanide fumigant in powder form was on the market, the Port Elizabeth golf course became heavily infested with moles, and the entomologist there was asked to investigate. The mole-hills were very numerous on many of the fairways and seriously interfered with play. " Cyanogas " flakes were used and placed in the mole holes after they were opened and found free from any obstruction. About an ounce of the flakes was placed in each hole opened at intervals of 2 to 3 yards, and immediately after treatment the holes were closed with a plug of grass and soil in order to prevent the escape of the gas. After this preliminary treatment, every fresh mound was removed and the burrow given a dose of the fumigant. This method gave good results after repeated applications, judged by the few mounds that appeared subsequently. It is much more satisfactory if the fumes penetrate the burrows as quickly as possible, and for this reason materials applied by means of pumps are to be recommended. With gases that penetrate the burrows slowly, there is the likelihood of the inmate blocking up the runway with earth as soon as it detects the strange smell, with the result that no more gas can reach it.

The exhaust gases from a motorcar directed into the burrows through a suitable tube are said to kill mole-rats.

The mole cartridges, which are lit and pushed into the burrows, are declared by some users to give relief from mole trouble for a time, while others state that they are not effective.

Many other methods have been tried which, as repellants, may scare the moles and mole-rats away for a short time, but such methods are of little use. It is far better in the case of the " Kruipmol " to use the methods described above, and for the rodent moles to employ the proved methods of destruction. By these means the pest can soon be eradicated from lands and gardens.

Investigations on the Composition of South African Milk.

IV. The Influence of Monthly Variations in Air Temperature and Rainfall on the Composition of Milk.

S. Bakalor, Agricultural Research Institute, Pretoria.

VARIATIONS in the composition of milk from season to season have been noted by many dairy research workers. Some investigators have suggested causes for such seasonal variations, but, where conflicting findings have been reported, the causes of such variations have remained obscure.

The tendency of some investigators to regard each season of the year as being a period in which set climatic conditions occur, is the reason for much of this obscurity. For example, it may be assumed that winter is always a period of high rainfall or snow. While winter is, of course, the season when the lowest air temperatures occur, it is not always the wettest season of the year. Thus, in the Union, the western Cape Province receives most of its rainfall in winter. To the east of this area is the thin belt in which rainfall is not concentrated in any particular season of the year, while the remainder of the Union, which forms the bulk of the country, receives most of its rainfall during the summer months.

It is obvious, then, that in examining the possible causes of seasonal variations in the composition of milk, the individual effects of the most important climatic factors such as air temperature and rainfall should be studied, rather than, for example, the variations in the fat or solids-not-fat (S.N.F.) content from winter to summer.

In previous articles of this series (2) (3), this question of the seasonal factors affecting composition was discussed with special reference to the area from which the Pretoria city-milk supplies are drawn. It is now proposed to examine the possible effects of monthly changes in air temperature and rainfall on the milk supplies of the dairy industry in various parts of the Union. Use will be made of data on the composition of milk produced in the supply areas of condenseries situated at Robertson, Estcourt, Franklin and Bergville (4), as well as of results given by Sinclair (8) for official samples taken in the Cape Peninsula. As all this data relates to long periods, ranging from five to seventeen years, the influence of monthly changes in weather on the composition of milk are not likely to be obscured by other factors.

It should be noted that, whereas the results received from condenseries (4), relate to the immediate past, Sinclair's data (8) were first published in 1924 and probably cover a much earlier period. This is still, however, the only set of published data on the monthly variations in the composition of milk produced in this area, over a period as long as fifteen years.

Variations in Fat Content.

Nearly all South African research (in common with much work done overseas) shows that the fat content of milk tends to rise towards the cold period of the year, and to decline in the warm period (spring and

summer) (3). It appears then, that air temperatures may have some influence on the compositon of milk.

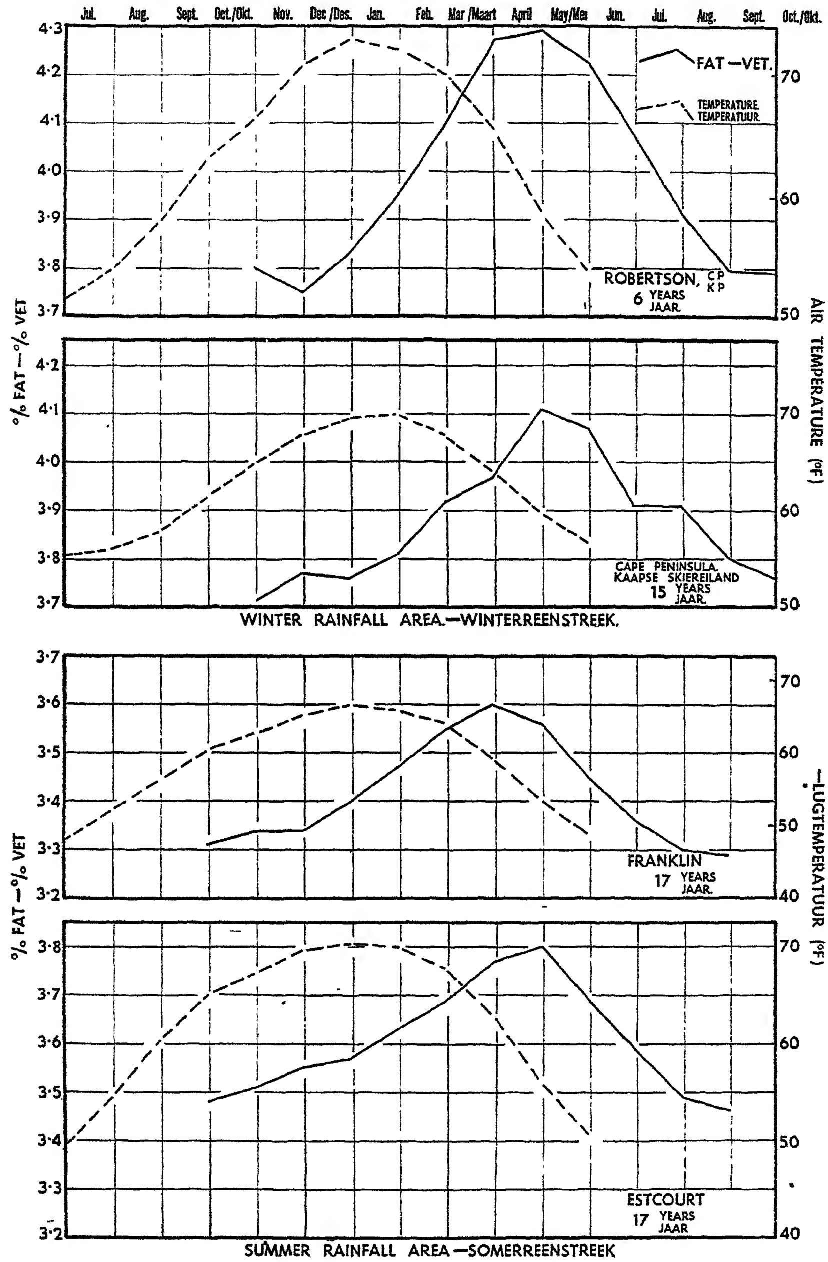

FIG. I.—Monthly Variations in Mean Air Temperature and in the Fat Content of Milk.

Kirkham and Barnes (6), working in East Africa, claim from data obtained during one year, that there is a positive relationship between the mean fat content of milk produced in any month and the mean air temperature, three months earlier. In other words, they claim that the

percentage fat in the milk produced, say, in April is affected by the mean air temperature for January of the same year.

In order to clarify this problem of the connection between the fat content of milk and air temperature, the possible statistical relationship (or correlation) between the mean fat content of milk produced in any month, and the mean air temperature of that same month, or of any of the other eleven months, was determined for the various areas except Bergville, indicated in Table I. (There is no temperature-recording station in the Bergville area.)

TABLE I.—*Monthly Variations in the Fat Content of Milk produced in Various Areas.*

	Winter-rainfall Area.		Summer-rainfall Area.		
	Robertson.	Cape Peninsula.	Estcourt.	Franklin.	Bergville.
	%	%	%	%	%
October	3·79	3·76	3·48	3·31	3·57
November	3·80	3·71	3·51	3·34	3·61
December	3·75	3·77	3·55	3·34	3·65
January	3·83	3·76	3·57	3·40	3·71
February	3·95	3·81	3·63	3·47	3·79
March	4·11	3·92	3·69	3·55	3·91
April	4·27	3·97	3·77	3·60	4·00
May	4·29	4·11	3·80	3·56	4·02
June	4·23	4·07	3·69	3·45	3·81
July	4·07	3·91	3·59	3·36	3·71
August	3·91	3·91	3·49	3·30	3·53
September	3·80	3·80	3·46	3·29	3·51
Period (Years)	6	15	17	17	5

The monthly variations in mean air temperature for these four areas are given in Table II.

TABLE II.—*Mean Monthly Air Temperatures.*

	Winter-rainfall Area.		Summer-rainfall Area.	
	Robertson.	Cape Peninsula.	Estcourt.	Franklin.
	°F.	°F.	°F.	°F.
October	62·9	61·1	65·1	60·6
November	66·1	64·8	67·3	62·5
December	70·9	67·8	69·6	65·3
January	73·0	69·5	70·8	66·4
February	72·0	69·9	69·8	66·0
March	70·0	67·8	67·8	63·8
April	65·5	64·0	62·8	59·3
May	58·5	59·9	55·9	53·6
June	53·6	56·7	50·5	48·8
July	51·4	55·3	49·9	48·1
August	53·8	56·0	54·9	52·4
September	57·7	57·8	60·4	56·3

In no case was any correlation found between the mean fat content of milk and the air temperature of the same month. Reference to Tables I and II shows that, as in the Pretoria City-milk supply area ([3]), the lowest means for fat and air temperature never occurred in the same month. The same is true for the highest means for these two factors. These two tables do show that milk tends to become richer in fat as winter approaches, but it will be noted that the coldest time of the year is usually in July—two or three months after the mean fat content of milk has reached its peak.

A strong positive relationship was, however, found between the fat-content of milk and the mean air temperature, four months ahead, in the two areas (Cape Peninsula and Robertson) receiving rain during the winter. In the case of the other areas, where rain falls during the summer the strongest correlation was found to occur with the mean air temperature, three months ahead. That the fat content of milk (after a lag of three or four months, depending on the area) follows a trend from month to month, similar to that of mean air temperatures, is clearly indicated in Fig. I.

The averaged results of temperature-recording stations, throughout the Union over a long period ([7]c), show that January is usually the month with the highest, and July the month with the lowest, mean air temperature. It would be expected, then, that the percentage fat in milk produced in any portion of the summer-rainfall area, would, on an average, be highest in April, and lowest in October. The monthly variations in fat content, calculated by Abbott ([1]) for milk produced throughout the Union (mainly the summer-rainfall area), show that this is indeed true for the country generally.

NOTE.—Another aspect of the relationship between milk-fat and air temperature is shown in Fig. II. (The graphs for other areas are similar to those of Estcourt. Even where the strongest positive correlation exists between the means for fat and for air temperature four months ahead, the graphical relationship is similar to that shown in Fig. II (*b*). For this reason, the data for Estcourt alone, is illustrated.)

When the mean percentage fat is plotted against the mean air temperature of the same month, a peculiar ellipsoidal figure is formed. [(Fig. II (*a*)]. It is obvious that the mean for fat in milk produced in any month, could not be estimated, if the mean air temperature of that particular month were the only data known. For example, if this mean air temperature were about 60° F. (as may occur in both the April–May and September–October periods in Estcourt), it would appear from Fig. II (*a*) that the mean fat test could be either above 3·75 per cent. or below 3·5 per cent. Such information is, of course, meaningless. Fig. II (*b*), however, shows the strong positive correlation between the means for fat and the air temperature, three months ahead.

In studying the seasonal variations in the fat content of milk, it should not be assumed that the milk produced in any month must necessarily differ in the amount of fat it contains from that produced in either the preceding or the following month. It is only to facilitate the study of seasonal trends that the composition of milk is averaged on the basis of calender months. Indeed, it can be seen from Table I, that during the end of the year period (September to January) milk in most areas alters very little in its average fat content. Usually it takes periods of more than one month for milk to change significantly in this respect. In Estcourt, for example, February milk is only on an average, 0·06 per cent. higher in fat than January milk, and March milk, also 0·06 per cent. higher than February milk. Such small changes are neligible, but the fact that March milk is 0·12 per cent. richer in fat than January milk, shows that there has been a significant rise in fat content over these three months. As the percentage fat in milk is usually determined to the first decimal place only, it will be seen that differences of less than 0·1 per cent. between means have no significance. (This has also been

proved for the present data by statistical methods.) Slight deviations from the rule of a three- or four-months lag between the mean air temperature and the fat test of milk may also be explained in this way. Thus if April, in any area, should theoretically be the month with the highest mean fat test, but the figure for this month is 3·52 per cent. compared with the actual highest test of 3·57 per cent. for May, it merely implies that there has been no real change in the richness of milk during this period. The general principle of the lag in time still remains true.

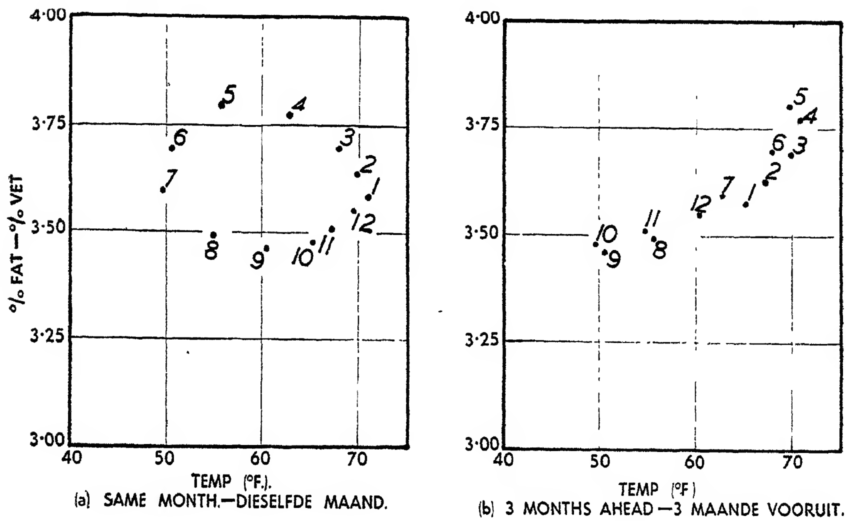

FIG. II.—Relationship between the Monthly Means for the Fat Content of Milk and the Temperature of the Air in the Estcourt Area (17-year Period).(Months of the Year indicated by Number).

(It can, of course, be noted from Table II, that there are times of the year in some areas, when the month-to-month change in mean air temperature is also slight. For example, at Franklin, this figure changes from 48·8° F. to 48·1° F. from June to July, and in the Peninsula from 69·5° F. to 69·9° F. from January to February).

The question must now be asked to what is the cause of this relationship between the fat content of milk and the temperature several months ahead? It appears difficult to believe that there could be any direct biological connection between these two variants. Even if it were to be assumed that the temperature first affected the veld grass, eaten by cows, and thus indirectly affected the milk, the total period of the delayed effect could not be more than a few weeks. Furthermore, it has been established that feeding has no influence on the fat content of milk.

The only fact that can be proved is the one noted earlier, i.e. that the month-to-month variations in fat content of bulked milk follow a trend (after a lag in time) similar to the corresponding variations for mean air temperature. The reason why there should be a lag of about three or four months between the highest mean air temperature and fat percentage, etc., has not yet been established. It certainly cannot be related to systems of calving, as there is a great deal of overlapping in the lactation periods of cows. If the vast majority of cows throughout the country completed their lactation periods in May and June, the high fat tests for these two months could be easily understood, as the milk

of the individual cow is richest in fat at the end of her lactation period (3) (9). The commercial dairy farmer has, however, to distribute calvings in his herd (or herds) as evenly as possible throughout the year. In the Pretoria city-milk production area it appears that monthly variations in the composition of herd milk are more related to climatic factors, than to any differences in calving systems (3).

Why the onset of cold weather, rather than the coldest weather, apparently causes milk to become richer in fat, and similarly, why the approach of warm weather, rather than the hottest weather, is associated with a decline in fat content, are problems that have still to be solved. If air temperature does have any influence on the milk fat, it probably does so as part of a complex group of interacting factors, the exact nature of which requires further study.

Effect of Rainfall.

In the summer-rainfall area, e.g. at Estcourt and Franklin, there is, of course, a strong positive relationship between temperature and rainfall. In the winter-rainfall area, with its dry summers, this relationship is obviously negative. The trends for rainfall in the various areas are shown in Table III, and, except for Bergville, are illustrated in Fig. III.

TABLE III.—*Monthly Variations in Rainfall.*

	Winter-rainfall Area.		Summer-rainfall Area.		
	Robertson.	Cape Peninsula.	Estcourt.	Franklin.	Bergville.
	ins.	ins.	ins.	ins.	ins.
October	1·10	2·17	2·07	2·35	3·67
November	0·31	1·41	4·05	4·02	4·26
December	0·86	1·12	4·02	4·81	3·79
January	0·51	0·91	4·63	4·81	6·07
February	0·24	0·65	4·64	4·97	5·54
March	0·75	1·11	3·54	3·75	5·58
April	0·99	2·40	1·85	1·78	2·83
May	1·99	4·53	0·98	0·96	0·88
June	1·88	5·61	0·42	0·53	0·72
July	0·95	5·00	0·65	0·51	0·65
August	1·32	4·68	0·66	0·72	1·44
September	1·54	3·23	0·99	1·26	1·23
Annual Total	12·44	32·82	28·50	30·47	36·66
Period (Years)	6	25	17	17	5

As was to be expected, the monthly mean for fat in the Estcourt, Franklin and Bergville areas is related to the mean monthly rainfall in the same way as it is to mean monthly air temperature, i.e. there is a lag of about three months between the month of lowest rainfall (July) and the month when the milk poorest in fat is produced, etc. (See Fig. III). In the Cape Peninsula and Robertson there is no significant relationship between fat and rainfall.

Rainfall has apparently no effect on the mean fat-content of milk. The only explanation of the relationship between fat and rainfall in the summer-rainfall area is that in this part of the country the trends for temperature and rainfall are so closely similar.

Variations in Solids-Not-Fat Content.

The variations in the solids-not-fat (S.N.F.) content of milk from month to in the Cape Peninsula and Bergville areas are shown in Table IV. This data will be used to illustrate the effect of climatic factors on S.N.F. content.*

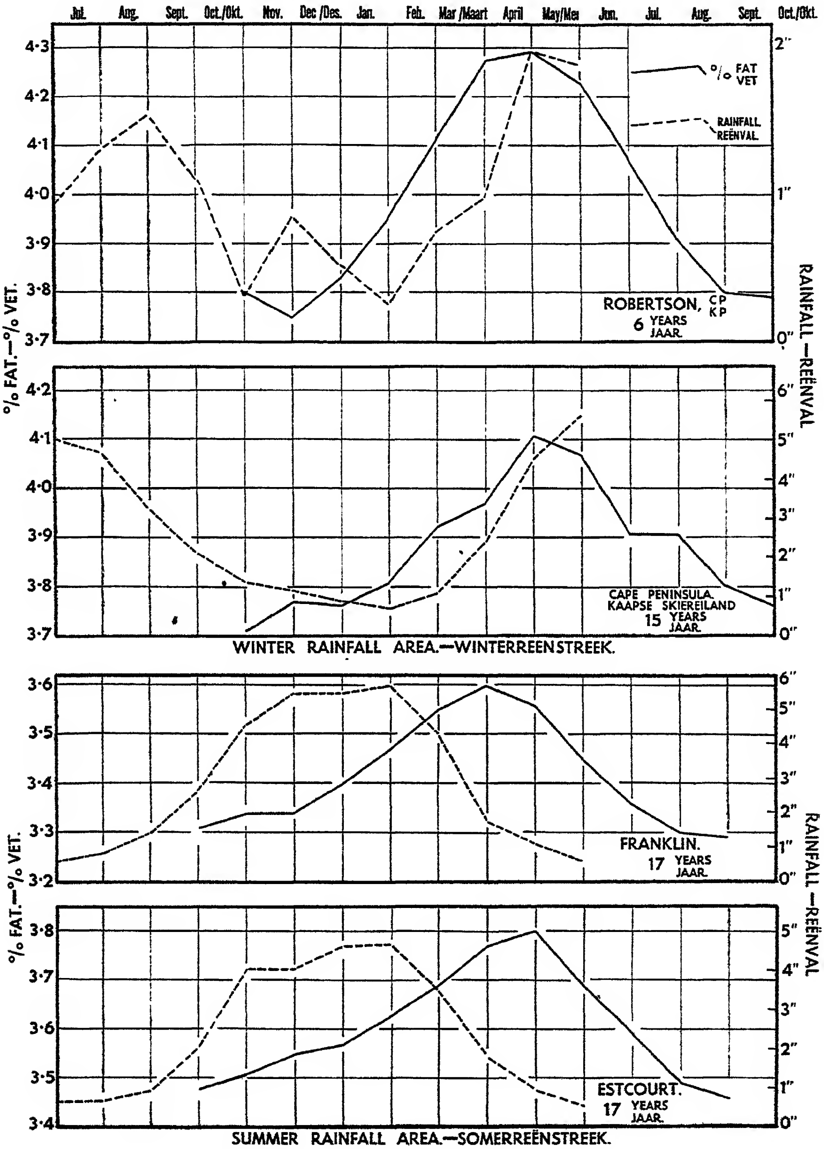

FIG. III.—Monthly Variations in Rainfall and in the Fat Content of Milk.

* Overseas findings (5) and certain unpublished data obtained at this laboratory, appear to indicate that the accuracy of S.N.F. estimations, based on Richmond's formula, varies from season to season. It was thus decided not to use the S.N.F. data (based on this formula) from other areas, for this study.

TABLE IV.—*Monthly Variations in the S.N.F. Content of Milk.*

	Winter-rainfall Area. Cape Peninsula.	Summer-rainfall Area. Bergville.
	%	%
October	8·53	8·50
November	8·52	8·58
December	8·51	8·58
January	8·48	8·53
February	8·44	8·67
March	8·52	8·61
April	8·60	8·56
May	8·61	8·44
June	8·63	8·47
July	8·65	8·44
August	8·62	8·33
September	8·56	8·37
Period (Years)	15	5

In the Pretoria city-milk production area it was found that the S.N.F. content of milk was high in the rainy season of the year, and comparatively low in the dry, late winter and early spring (3). In the above-mentioned two areas a strong positive relationship was also found between the monthly averages for S.N.F. and rainfall (See Fig. IV). This relationship persists, despite the differences in the time of the rainy season.

It has been shown that the rise in S.N.F. content, associated with the first heavy rains of the season, is probably due to the increased nutritive value of pastures as a result of such rains (3). The S.N.F., and especially the lactose, content of milk (unlike the fat percentage) appears to be affected in some way by feeding. The young grass, when eaten by cows which, during the dry season, may have been affected to some extent by underfeeding or malnutrition, apparently results in the secretion of milk fairly high in S.N.F.

(The observations made earlier with reference to the significance of differences between monthly means for fat, are also of application to the S.N.F. Where the means for S.N.F. of two adjacent months differ by less than ·0·1 per cent., it can generally be assumed that there is no significant difference between the S.N.F. content of the milk of the two months.)

Table V again illustrates the strong relationship existing between the S.N.F. content of milk and rainfall, when the year is studied quarter by quarter.

TABLE V.—*Mean Monthly Rainfall and Mean Test for S.N.F. in Milk, in the Various Quarters of the Year.*

Quarter.	Cape Peninsula.		Bergville.	
	Rainfall.	S.N.F.	Rainfall.	S.N.F.
	Ins.	%	Ins.	%
1st	0·89	8·48	5·73	8·60
2nd	4·18	8·61	1·48	8·49
3rd	4·30	8·61	1·11	8·38
4th	1·57	8·52	3·91	8·55

In an intensive one-year survey of the supplies of a Pretoria city-milk plant, the amount of milk analysed per month, which conformed to the 8·5 per cent. standard for S.N.F., was determined. This was found to vary from about 50 per cent. of the supplies in the dry August-September period to over 92 per cent. in November—a month of high rainfall (3). Similar data for the Bergville condensery are presented in Table VI.

TABLE VI.—*Percentage of Total Number of Batches of Milk analysed per Month conforming to the 8·5 per cent. Standard for S.N.F.*

(*Bergville*: *Single-Year Period*).

Month.	*Percentage.*	*Month.*	*Percentage.*
October.........	66·0	April...........	47·9
November.......	83·5	May...........	47·0
December........	80·5	June...........	45·7
January..... ...	63·3	July......	36·4
February...... .	63·5	August..........	....5·4
March..........	71·4	September	19·9

These figures are a further illustration of the influence of rainfall on the S.N.F. content of milk.

In the summer-rainfall area, milk is highest in S.N.F. in the middle of summer, and in the winter-rainfall area in the middle of winter. There is thus no consistent relationship between air temperature and S.N.F. Temperature, probably, does not affect the S.N.F. content any more than rainfall affects the fat content of milk.

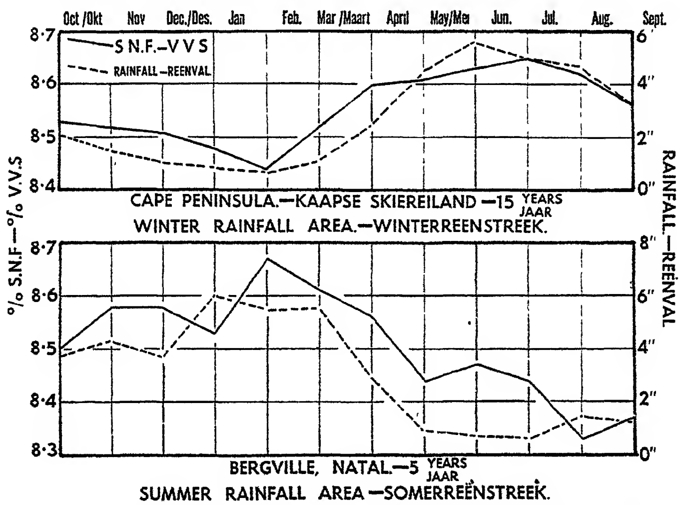

FIG. IV.—Monthly Variations in Rainfall and in the S.N.F. Content of Milk.

The S.N.F. in milk is, of course, not a single constituent, but a group of constituents (ash, proteins and lactose). In dairy factories and public health laboratories these various constituents are not, as a rule, determined. The only data in this country from which the seasonal variations in the ash, protein and lactose, as well as the other constituents of milk can be studied, formed the basis of the reports of this Institute on the Pretoria city-milk production area (2) (3).

In this area, the highest monthly averages for the S.N.F. (as a whole), as well as for the lactose and ash contents of milk occurred during the month of the first heavy summer rains. The protein content, however, reached its peak during the late summer (February and March),

but also fell to its lowest level during the dry late winter. For a fuller discussion on the influence of climatic factors on these constituents, reference should be made to the second of the above reports (3).

The Effect of Seasonal Variations in Production on the Composition of Milk.

It is commonly known that the dairy industry suffers from a shortage of milk during the dry period of the year, and receives its biggest volume of supplies during, or just after, the rainy period. The seasonal trends in the quantity of milk supplied to the Pretoria city-milk trade, as well as to a factory in each of the main rainfall areas, are given in Fig. V. This diagram shows that in the city-milk area, where more supplementary feeding is practised than in areas where milk for manufacturing purposes is produced, the drop in production during winter is least severe. Shortages in the supplies of cities are often avoided, too, by the purchase of milk from other areas.

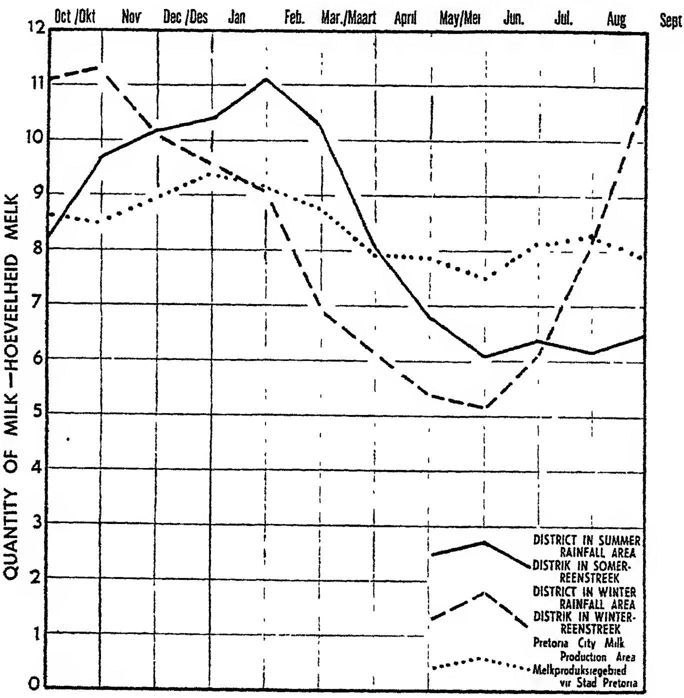

FIG. V.—Monthly Variations in the Quantitv of Milk produced in Various Areas. (Total for Year in each case = 100).

Although volume of production is strongly correlated with intensity of rainfall in areas such as Estcourt and Bergville, the relationship between these two factors appears to be slightly different in Robertson (winter-rainfall area). Here the heaviest production of milk occurs from July, onwards, to the commencement of the new year, i.e. just after the rainy season. It may be that the pastures in this area are not at their best until temperatures begin to rise again (in early spring) and thus the expected effect of rainfall on production is delayed. The Robertson area is supplied during summer with irrigation water which reduces, to some extent, the dependence of its production on the very scanty annual rainfall.

In the Bergville and Estcourt areas, production is at its highest in the hot summer months. In Robertson, however, the bulk of the annual output is produced in the slightly cooler months of spring and early summer.

Having considered the effect of climatic conditions on production, the influence of production, in turn, on the quality of the milk must now be considered.

In the Bergville and Estcourt districts, no relationship was found between the fat content and the amount of milk produced per month. A study of Table I and Fig.I reveals that in these districts (in the summer-rainfall area) the mean fat percentage reaches its peak in May, and is at its lowest point in the September-October period. All these months fall in that portion of the year (winter and spring) in which the amount of milk produced is very low. At Robertson, on the other hand, production reaches its peak during the months when the milk is poorest in fat (September to January.) This is similar to what occurs during the lactation period of the individual cow i.e. at the beginning of lactation production is high and the fat-test fairly low, but at the end production is low and the milk is much richer in fat ([9]).

When production is at its highest level in Bergville, the milk is also richest in S.N.F. As, in this area, both the S.N.F. content and production are positively influenced by rainfall, the above-mentioned relationship between S.N.F. and production was to be expected. No data were available to indicate whether a similar or different position exists in the winter-rainfall area.

In studying the effect of climatic factors on composition, it must be remembered that, while intensity of rainfall, etc., may cause variations in the solids content of milk from season to season, the general standard of milk in an area, i.e. its mean composition throughout the year, is influenced by the large number of interacting factors which are known to affect the chemical quality of milk, such as prevalence of diseases, breeding, etc. ([3]).

Acknowledgments are due to:

(1) The Dairy Industry Control Board for providing the funds necessary for this investigation.

(2) Messrs. Nestlè (S.A.) Ltd. and Messrs. Union Milk Products, Ltd., for data on the milk supplies of their factories.

(3) The staff of the head office, Division of Meteorology, Department of Transport, for unpublished meteorological data.

(4) The Secretary, Pretoria Milk Distributors' Association, for statistics relating to the amount of milk purchased monthly by the Pretoria distributive trade.

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* Reports being prepared for publication.

Fertility in Rams :-

[*Continued from page* 218.

One or both epididymides or portions of these bodies may be affected. In the initial stage of inflammation of the tail (cauda), this portion may be only slightly enlarged, but this condition can usually be detected inasmuch as the dividing line between the tail of the epididymis and the testicle is no longer easily discernable and the tail seems to fold over the testicle.

In Southdown rams, even healthy ones, the dividing line is very faint, but in all other breeds it is clearly discernable.

(3) *Enlargement of the testicle.*—Where this conditions occurs, the testicle itself is enlarged. It may be soft, like a relaxed muscle or taut like a strained muscle. One or both testicles may be affected.

(4) *Atrophy (wasting) of the testicle.*—This is the opposite of the condition described above and here the testicle is smaller than normal. Usually the testicle is soft. It should be noted that the two testicles of a healthy ram are seldom exactly the same size and, consequently, a small difference in the size of the testicles must not be regarded as abnormal.

(5) *Scrotal tumours.*—The testicles should always be able to move freely in the scrotum and should not grow into the latter.

There is a very strong possibility that susceptibility to this abnormality may be hereditary and farmers are therefore strongly recommended to have regular clinical examinations made of their rams and to cull all those showing clinical signs of abnormalities immediately, even in cases where only one testicle is affected.

Research work in this connection is being continued, since there are still many unsolved aspects to this problem. But even at this stage it is essential that the attention of farmers should be drawn to this threat which has already assumed larger proportions than was formerly realized.

Crops and Markets.

As from this issue, *Crops and Markets* will no longer appear as a supplement to *Farming in South Africa* but as a separate publication in cyclostyled form. Interested persons who are anxious to receive the publication are requested to forward their names and addresses immediately to the Chief:. Division of Economics and Markets, Union Buildings, Pretoria.

The Farm Home.

(A section devoted mainly to the interests of Farm Women.)

The Care of Furniture.

Mrs. N. M. Seegers, Home Economics Officer, Department of Soil Conservation and Extension.

FURNITURE IS usually bought only once in a lifetime. Great care should therefore be taken of pieces of furniture and the owner will be amply repaid by their increased value and improved appearance.

The wood in a house may be divided into two groups, viz.

(1) white or unpolished wood, and,

(2) wood finished with some preparation such as polish or oil.

(A) White or Unpolished Wood.

This type of wood is usually used for articles such as kitchen tables, pantry shelves, floors, etc. Unpolished wood is cleaned as follows: Remove all surface dirt with a blunt instrument, preferably a wooden one. Scrub the wood with a scrubbing brush, but never use a very hard brush. Be sure not to scrub against the grain of the wood as it will cause splintering. A hard brush will cause splintering too, and also wearing away of the soft portions of the wood. Use lukewarm water, soap and a dish cloth. The use of very hot water will cause swelling and consequently splintering of the wood; it will also cause discolouration. The use of washing soda or too much soap will have the same effect. Wash a small portion at a time and rinse with cold water; this will help to keep the wood white. Rinse and dry the portion well, before proceeding to the next. Unless the wood is dried well, it will become discoloured and will soon splinter. See that the portions washed overlap, otherwise dirty rings will remain when the wood has dried. A mild scouring agent may also be used. It will help to keep the wood white. Any stubborn fatty marks may be removed with a paste made from benzine and whiting applied on the spots and then left to dry. The process may be repeated if necessary.

(B) Finished Wood.

Finished wood may be divided into the following classes:—

(*a*) *Painted wood.*—Cheap wood and wood with an ugly surface are given a few coatings of enamel paint. When cleaning such surfaces, remember not to use anything likely to remove or scratch the paint. Painted furniture must be dusted regularly and once this is ineffective, recourse must be had to washing.

For light colours use a soft soap and lukewarm water and wash with a cloth without a pile, since the fluff will adhere to the paint. Avoid alkalis, heat, friction and excessive moisture, as well as solvents, such as turpentine. Rinse with slightly lukewarm water, which will remove the soap more effectively than cold water. Wash a small portion

at a time so that the water does not remain on the surface too long, since dampness will cause the paint to peel off. Dry the surface well. Spots on white paint may be removed with whiting which should be thoroughly rinsed off afterwards since it may form a white precipitation.

Dark, painted surfaces must be washed as above, but instead of soap, 1 tablespoon of paraffin is used to ½ a bucket of lukewarm water. This removes all greasiness and is a good polish. If the smell of paraffin is undesirable, soap may be used, but it is inclined to leave marks. Do not use too much paraffin, since, with continuous use, it will dissolve and remove the paint. Articles, such as doors which are exposed to wind and weather, may be cleaned with a cloth dipped in a little paraffin. This will also prevent the paint from peeling off. A little raw linseed oil may also be used as a protective layer over the paint.

Enamel surfaces are treated in the same manner as paint. Afterwards they are rubbed with a soft cloth.

Coloured and varnished woods are washed with lukewarm soapy water. Hot water must not be used as it will dissolve the varnish. When dry, the articles may be polished with a soft cloth or a cloth dipped in a little raw linseed oil.

(*b*) *Wood with a polished surface.*—The more durable woods with a natural attractive colour, grain and surface, such as kiaat, stinkwood, tambootie, embuia, walnut, mahogany, etc., are treated in various ways to preserve the woods and improve their appearance.

(1) *French polish.*—This type of finish requires much time and skill. The polish consists of a mixture of shellac dissolved in methylated spirits or alcohol and is applied very carefully to the surface of the wood. This finish should receive very special care, since it easily shows marks which cannot be removed unless the whole surface is treated again. Avoid any heat, since it will remove the polish, leaving white marks. Take care not to scratch the surface, since the scratches are extremely difficult to remove. Small scratches can be rubbed with methylated spirits and then with raw linseed oil, to make them less conspicuous, but for bigger scratches, the French polish will have to be removed altogether and the article repolished. Water will also leave marks and cause the formation of small cracks in the surface. It is extremely difficult to remove brandy marks. First remove the white marks by rubbing the surface with a little raw linseed oil, and then polish with a good furniture cream. Brandy contains alcohol which dissolves the polish. Be careful not to spill medicine or perfume on the surface, since they contain chemicals which will also dissolve the French polish. Ink will also leave marks unless it is removed immediately.

Daily dusting and polishing will keep French polished surfaces in good condition for a long time. If necessary, a little furniture cream may be used, but it must be rubbed off immediately. Raw linseed oil may be used instead of furniture cream; but do not use it too often. If the furniture is very dirty, it may be washed. In this case, proceed as follows: Thoroughly dust the piece of furniture and wipe the surface with a soft cloth dipped in lukewarm soapy water and wring out slightly. Treat a small portion at a time and see that the surface does not become wet. Now wipe the furniture with a cloth moistened with lukewarm water or water to which a little vinegar has been added (2 tablespoons of vinegar to 2 cups of water). Thoroughly dry the article which may then be polished with a mixture of two parts of raw linseed oil and one part of vinegar. Polish well with a dry

cloth to remove all excess oil. This mixture of raw linseed oil and vinegar imparts a beautiful gloss to furniture.

(ii) Instead of finishing with French polish, one may also polish the furniture with raw linseed oil after rubbing it with emery paper. This darkens the wood and imparts a slight shine. Water marks are easily visible on this finish, but can be removed by rubbing the surface with raw linseed oil.

(iii) The wood may also be polished with a mixture of *beeswax and turpentine*. This requires regular hard polishing but imparts a beautiful shine and preserves the natural colour of the wood. Water marks show up easily on this surface but can be removed by rubbing with turpentine and beeswax. For carved wood it is best to use a liquid furniture cream.

Removing Stains and Marks.

Scratches, heat marks, perfume and alcohol stains, etc., can be made less noticeable by rubbing with a little raw linseed oil and carefully polishing the surface.

Ink stains can be rubbed with vinegar and water after most of the ink has been removed with blotting paper. The vinegar dissolves the iron and the dye is removed by the water.

For light scratches and dents, fold a piece of brown paper a few times, moisten and place over the mark. Now iron the paper with a hot iron until dry. This method can only be applied in the case of furniture with no shellac in the finish.

Furniture, especially if manufactured from light woods, is often attacked by woodborers. To control these insects, the holes in the wood can be sprayed with paraffin or carbolic acid. D.D.T. may also be used, but since this leaves white marks, it should be applied only on invisible portions. Furniture finished with French polish is less subject to attack but the unprotected portions must be treated by rubbing with beeswax or something similar. The wood may also be sprinkled with powdered alum dissolved in water or turpentine.

Polishes.

The following recipes will be found useful:—

(1) *Liquid polish*—excellent for carved furniture.

¼ cup of paraffin,	1 cup of raw linseed oil,
¼ cup of turpentine,	¼ cup of vinegar,
¼ cup of methylated spirits.	

Mix all the ingredients in a bottle and cork securely. Shake well before use.

(2) Mixture of raw linseed oil and turpentine in equal quantities.

(3) Raw linseed oil and vinegar in equal quantities. Especially suitable for furniture finished with French polish.

(4) *Furniture cream.*—The following is excellent for furniture.

¼ lb. of beeswax,	1 pint of turpentine,
2 ounces of paraffin-wax,	1 ounce of soap,
1 pint of boiling water.	

Melt the beeswax and paraffin. Remove from the fire and add the turpentine. Dissolve the soap in boiling water and thoroughly mix the two mixtures. If it is too soft, more beeswax may be added.

Renovating Neglected Furniture.

All furniture with an old and ugly finish, can be renovated by the following treatment. First remove the old finish with some solvent. Commercial solvents are obtainable for a specific finish. Instead of a commercial solvent, a mixture of ammonia, washing soda or caustic soda may be used.

1 lb. of washing soda to 5 to 6 quarts of water.
1 tablespoon of caustic soda to 4 cups of water.

The solvent is left on the article and then removed with a blunt knife or a piece of glass. Scrape it off in long strokes, working along the grain of the wood. When all the finish has been removed, wash the wood with vinegar water to neutralize the alkali. See that the wood is not too wet, as this will cause warping. After washing with vinegar water, rub the wood with sandpaper to obtain a smooth surface. If the grain is coarse, a filling may be used—either a commercial preparation or one made at home. The filling is applied in circular strokes and then smoothed with sandpaper along the grain. All holes and cracks may be filled up with putty or plastic wood. If necessary, the wood may be dyed with permanganate of potash, logwood or commercial dye.

Sandpaper again. The wood is now ready to be finished off with polish, oil, varnish, paint or shellac. If polish is used, oil is applied first. The wood may also be finished with French polish.

Recipe for Wood Filling.

1 pint of boiled linseed oil, 1½ pints of turpentine,
1 pint of whiting or maize flour.

(This makes a white filling which can be darkened later by the addition of commercial dyes.)

Upholstered Furniture.

This type of furniture must be dusted and, if so desired, brushed daily. For removing surface dirt and brightening the colours, hot bran may be used. Sift the bran and use only the coarse portion. Heat the bran in an oven and rub it into the material after dusting thoroughly. Badly soiled portions such as the back where the head rests, can be moistened with petrol or benzine before the bran is applied. After rubbing the bran thoroughly into the whole article, it is sprinkled with hot bran. It is then covered with an old sheet and left overnight. The following morning the article is thoroughly brushed off. Repeat the process if necessary. Vinegar and water (1 tablespoon to a quart) can also be used. Avoid excessive wetting of the material.

Wicker Chairs and Tables.

These articles should be brushed off and dusted regularly. If very dirty, they may be washed with soap and lukewarm water. Salt and water may be used for articles which are not very dirty. Excessive wetting must be avoided and the articles must be placed in a spot where rapid drying is possible—for example in a draught. Grease stains on chairs can be removed by sponging with ammonia and then with vinegar water.

Carpets.

The life of a carpet depends not only on the quality but also on the treatment which it receives. A carpet should lie on a smooth surface, and should not come into direct contact with the floor, but

should have a layer underneath. It must be cleaned every day by sweeping or brushing with a hard brush.

Moist tea leaves or pieces of damp newspaper may be strewn over the carpet to remove excess dust. Brush in the direction of the pile. A vacuum cleaner is of course, ideal for removing all the dust and dirt. It will be necessary to take the carpet outside regularly for a thorough brushing. Hang it over a washing line and beat on the wrong side, or place it on a lawn with the right side up and beat with a round stick. Wrap a cloth around the stick. Brush the carpet now and again. If the carpet is very dirty it may be washed as follows: You will need two cloths, a piece of good soap and a basin of hot water. Place the carpet right side up. Wash small portions with one of the cloths slightly soaped, working in circular strokes and rinse. Then dry with the other cloth in the direction of the pile. Do not make the carpet too wet and dry one portion well before proceeding to wash the next. Before the carpet is completely dry, the pile must be brushed up.

Home-made Carpet Soap.

Dissolve 2 tablespoons of soap in ½ a cup of water. When cold, add 2 tablespoons of ammonia. A vinegar solution (1 tablespoon of vinegar to 2 pints of water) may be used instead of the soap solution. This will brighten the colours. Stains should be removed immediately. Some stains can be removed by washing only. Candle grease is removed by first scraping off the worst, covering the remaining patches with blotting paper and ironing with a hot iron. Soot must be removed carefully since soot stains are extremely difficult to remove. Sprinkle with fine salt and brush off lightly. Paint stains are removed with turpentine, and tar with bensol. Regular inspection for moths is imperative. If there are any signs of larvae, a damp cloth may be placed on the wrong side and the spot ironed with a hot iron.

Linoleum.

Proper care will prolong the life of linoleum considerably. Linoleum should never be scrubbed. Using hot water, soap and a soft cloth, wash a small portion at a time, taking care to allow it to dry well, since too much water will cause cracks. Linoleum will also last better if polished daily with beeswax and turpentine. Rub off well to prevent stickiness. Any other polish may also be used.

Artificial Insemination in Connection with Stud-breeding in Denmark:–

[Continued from page 258.

Many herds in these areas are not large enough to allow the owner to invest money in an excellent bull and here one often finds bulls which will never improve the existing stock. In certain areas where stud farmers are so near each other that it is a paying proposition for them to use each other's bulls, artificial insemination would lead to a much greater and more rapid improvement of stud stock than is witnessed at present. It is, of course, almost superfluous to remark that in such cases the association to which the breed belongs, must have its say in the matter and must, to prevent eventual fraud, frame regulations with regard to the officer who is carrying out the insemination and in regard to the control instituted by this group of farmers. The association must also reserve the right to exercise a kind of super-control over all the activities of the breeders applying artificial insemination in their herds. There is no denying the fact that in exceptional cases artificial insemination can be practised with great success, provided a spirit of co-operation and a willingness to submit to practical regulations and control are present.

Summary.

The writer would like to summarize his conclusions as follows:—

To exclude the artificial insemination of cattle in South Africa would be a retrogressive step and would deprive many stock owners in various parts of our country of the means of improving their stock quickly and economically. In cases where stud breeders wish to apply artificial insemination in order to make mutual use of each other's stud-bull, the association concerned with the breed should stipulate that its use be permitted provided the regulations drawn up by the society for that purpose are strictly and consistently adhered to.

New Bulletins.

Bulletin No. 284.—*The Feeding of Farm Animals (Dairy Cattle)*, by J. C. Bonsma, Division of Agricultural Education and Research, is obtainable from the Editor of Publications, Department of Agriculture, Pretoria. Price 3d., prepaid.

Bulletin No. 229.—*Soft-Cheese and Cottage Cheese* (Second and Revised Edition), by G. D. le Roux, Division of Dairying, is obtainable from the Editor of Publications, Department of Agriculture, Pretoria. Price 3d., prepaid.

Bulletin No. 286.—*The Litchi in South Africa* by Dr. R. H. Marloth, Division of Horticulture, is obtainable from the Editor of Publications, Department of Agriculture, Pretoria. Price 6d., prepaid.

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[*Photo on Cover* : The International Egg-Laying Champion.]

[NOTE.—Articles from *Farming in South Africa* may be published provided acknowledgment of source is given.]

G.P.-S.9—1948-9—8,350.

FARMING IN SOUTH ... AFRICA

VOL. 23 MAY 1948 No. 266

Editorial:

Conservation of our Veld and Soil.

IN considering the farming opportunities in the Union, the first point to be clearly appreciated is that at least two-thirds of the area of South Africa is semi-arid to arid, and inherently unsuited to intensive farming or crop production. On the remaining one-third of the country, therefore, falls the main burden of production of grain and protective foods for the nation. Furthermore, when it is realized that much of this portion is composed of mountainous or broken country, unsuitable for intensive farming, it will at once become evident that, apart from any other considerations, and despite the apparent great size of the country, we have by no means any land to spare or to waste. It is therefore incumbent on all of us to ensure the utmost economy in the careful husbandry of our land and other vital resources.

This is equally and pertinently true of the great semi-arid and arid regions of South Africa, which include the Transvaal lowveld, the western Transvaal, Griqualand West, the Karoo and adjoining sweet grassveld areas. In these areas, which are suited primarily to extensive stock farming, the principal source of production is the natural vegetation and the soil on which it grows. These two assets must therefore, be conserved at all costs. But in spite of this fact and notwithstanding the urgent recommendations made by the Drought Investigation Commission some twenty five years ago, the greatest advances in South African agriculture have been made in the sphere of crop production and animal breeding, while until recently the veld has recieved little attention or study. This is particularly true of the vast Karoo and adjoining grassveld areas, and it is therefore not surprising that the energetic policies pursued in the breeding of more highly developed animals, without taking into consideration the requirements of the veld or its ability to sustain them, have not proved an unqualified succes. In many instances the animal is being bred to a level where its nutritional requirements are in excess of what the veld is able to supply. When it is realized that this policy is being attempted on veld which, as a general rule, is deteriorating in quality and nutritional value, it will be patent that a gulf is rapidly widening which all the breeders' cunning will not be able to bridge, and that to seek increased production by pursuance of this course is to attempt the impossible.

From this it will be evident that, in the drier regions of South Africa, the two main lines of endeavour must be directed towards the conservation of the veld and, by breeding and selection, the adjustment of the animal to it. This will involve, in the one instance, carefully planned and detailed research in the management and restoration of our natural veld in all the different ecological regions of this great country; and in the other instance, energetic research directed towards the development of suitable breeds of animals capable of efficient and sustained production from the veld in the different ecological regions. This is an indispensable prerequisite to the realization of the ideal in practice, without which the

high aims of the recent Soil and Veld Conservation Act must, in arid South Africa, remain an unattainable goal.

Although much valuable work is being done in this direction and promising results have already been obtained at several of our agricultural institutions, such as the Grootfontein College of Agriculture, in the Cape Midlands, and the Towoomba and Mara Research Stations, in the Transvaal lowveld, the cold fact remains that we know as yet very little about our largest natural region, viz. the arid Karoo; and unless the work at the isolated points mentioned is augmented and extended throughout the arid and semi-arid regions of South Africa, we shall fall far short of the realization of our aims.

In this endeavour, a great weight of responsibility rests on the farmers themselves, whose keen aliveness to the magnitude of the problem of the rapid wastage of our greatest farming asset, the natural veld, is clearly evidenced by their great response to the new Soil Conservation Act; but as there is little point in preaching to the converted, it only remains to wish them all succes and to assure them that every effort in the field of research will be made in order to furnish them with the necessary information for the fulfilment of their great task.

(G. J. Schuurman, Principal, Grootfontein College of Agriculture, Middelburg, Cape.)

Importation of Livestock into the Union by Air.

THE following information is published for the guidance of organisations conducting air transportation services to the Union, and of persons contemplating the importation of livestock into the Union by air.

All animals and birds are "stock" for the purpose of the Diseases of Stock Act, 1911, (Act No. 14 of 1911), as amended, and the regulations framed thereunder, *and may not be imported into the Union by land, sea or air except under permit previously issued and through proclaimed Ports of Entry.*

In addition most imports are subject to conditions which are prescribed by regulation or Minister's Order, and all imports are subject to compliance with the requirements of the Principal Veterinary Officer.

A period of detention in a government-owned Quarantine Station in the Union is compulsory in the case of certain classes of stock (including cats, dogs and some other small animals) arriving in the Union from almost all countries.

There are at present only two such quarantine stations in the Union, namely those at Cape Town and Durban.

The quarantining of imported animals is not permitted in privately owned premises, kennels, etc.

Experience has shown that the danger of the introduction of disease is greater in the case of importations by air than by land or sea.

For those and other security reasons the Department of Agriculture is strongly averse to the importation of animals by air, and will in future exercise its rights to refuse the issue of permits for importations by air, except in cases in which quarantining is unnecessary and the animals can be released forthwith on landing.

Animals subject to quarantine should be consigned by sea to Cape Town or Durban.

 [*Continued on page* 303.

Agro-Climatology.

The Scope of its Application to S.A. Agriculture.

Miss Joan S. Whitmore, Division of Agricultural Education and Research.

THE post-war trends of increasing population, accelerated industrialization and recurring local and universal food scarcities, have all created a concomitant need for increased agricultural output. In view, however,

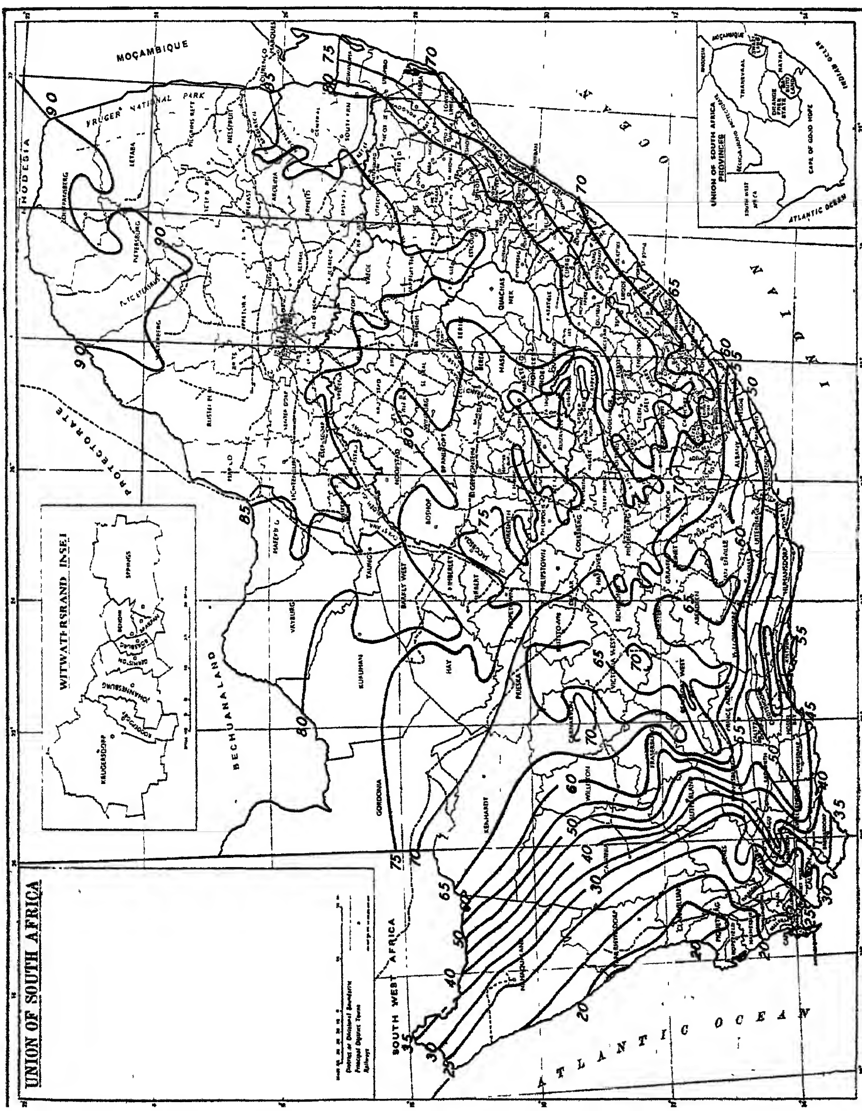

FIG. 1.—Seasonal distribution of rainfall. Percentage falling during Summer months (October–March).

of the progressive depletion of soil, water and vegetation resources this demand is difficult to meet and might appear anomalous. Authorities have indicated that the solution lies not so much in bringing new land into production, but rather in raising the existing standard of production and improving both the quantity and quality of yields. The problem then resolves itself into the fundamental adjustment of farming systems to conform to the natural controls, of which the most stringent is climate. An immutable and relentless factor, it as yet brooks no attitude of chal-

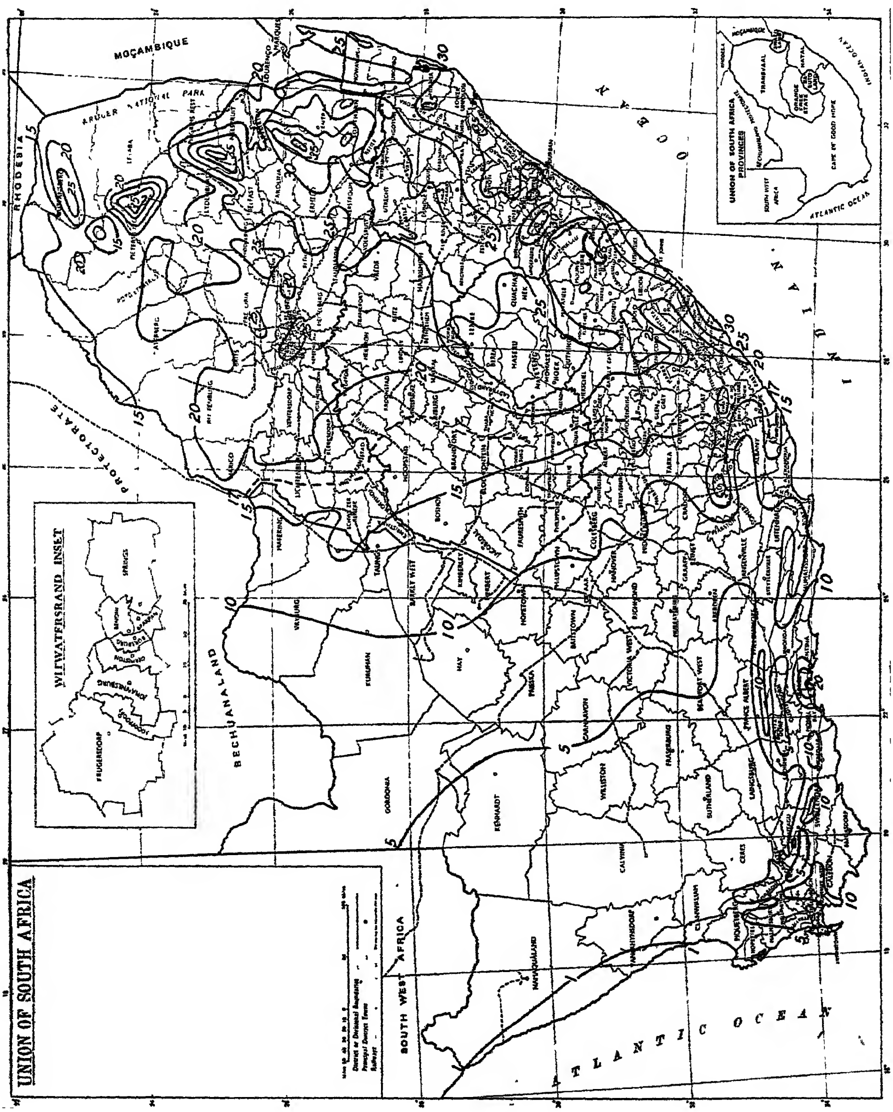

FIG. 2.—Mean Summer rainfall (inches) October-March.

lenge. But from a study of its vagaries it is possible to determine those regions, and seasons, that offer the most—or least—favourable conditions for the cultivation of certain crops or breeding of animals; consequently, farming practices can be adapted to utilize most profitablv that which the environment has to offer.

Influence of Climate.

Analyses of the available climatic records yield fundamental information about the various climatic elements such as precipitation, temperature, wind, evaporation—their seasonal distribution and intensity, their variability and many other aspects. By synthesizing these findings there follow deductions of basic importance to agriculture, for by this means there can be determined natural climatic regions where one or another control is dominant and others assume secondary importance, all interchanging in dominance from region to region. Reflected in the physiography and natural vegetation of a region, climate has a large measure of control over the land-use potentialities, and through its restrictive factors, such as extremes of temperature or precipitation, it governs the degree of intensity of utilization which the inherent qualities of the environment are capable of supporting.

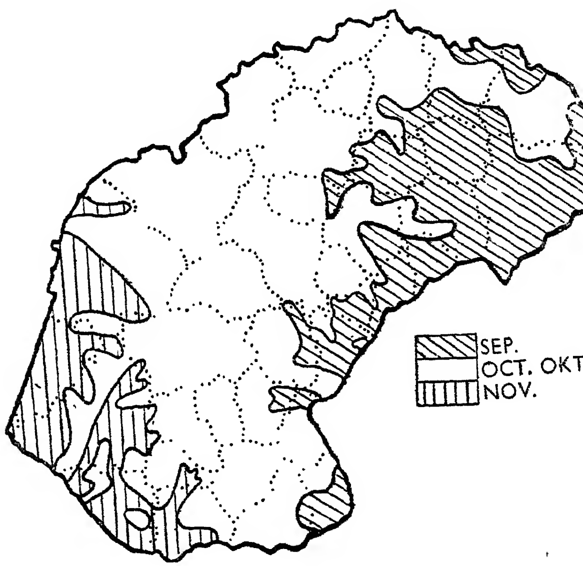

FIG. 3.—First month in spring with more than 1 in. rainfall.

The fundamental principle underlying the work in agro-climatology is the assumption that every useful crop and fodder plant and breed of livestock flourishes best under certain combinations of climatic factors that provide the optimum conditions for development. Successful growth can take place only within certain climatic limits, and the range of adaptability varies with each plant or animal under consideration; many drought and frost resistant varieties of wheat have been developed, for example, whereas sub-tropical crops exist only in a restricted environment. Through the study of the water and temperature requirements of plants and their optimal and marginal limits on the one hand, and on the other through a study of such factors as the length of the physiological growing season, the average time of occurrence of the first spring rains and the alternating spells of maximum precipitation and drought during summer, it is possible to indicate the most advantageous dates of planting and harvesting crops in different regions. These deductions as to climatic régime have their practical applications to all branches of farming, and are legion. They point to the regions where optimum conditions for specific summer, winter and perennial crops prevail, so that they can be

grown with a fair degree of assurance, and likewise to regions where, because of one or more critical climatic factors, the hazard is too great.

Salient Climatic Features of the Union.

As the present article on this subject can only be of an introductory nature, a series of articles will follow shortly dealing in greater detail with the various aspects of climate and their relation to argiculture, as well as synthesized regional studies of the Union. The following schedule attempts to outline, in the briefest form, the salient climatic features of the Union:

(1). Latitudinal position and its climatic implications.

The Union covers latitudes 22—35° S. and has therefore a position comparable to North Mexico, South California, much of Texas and Arkansas, Louisiana, Mississippi, Alabama, Georgia, South Carolina and

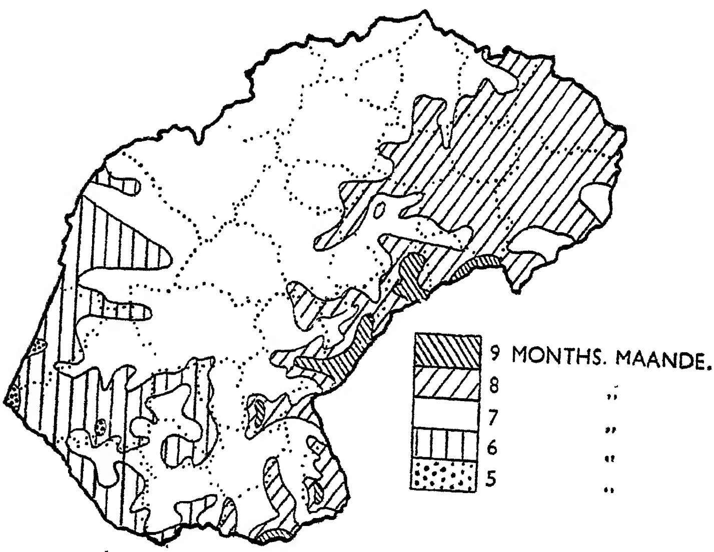

FIG. 4.—Duration of rainy season.

Florida in the U.S.A.; South Brazilian highlands, Paraguay, Uruguay, the Argentine as far south as the Plate River Estuary, and N. Chile in South America, and to New South Wales, South Australia, and the southern regions of West Australia and Queensland in Australia. The marked seasonal variability of climate, particularly rainfall, in the Union can be correlated largely with the location of the Union in the latitudinal zone characterised by alternating seasonal high and low atmospheric pressure belts.

(2). Physiography.

(*a*) The greater part of the Union consists of a vast tableland, highest in the east, with an elevation of over 3,000 feet, and a highland rim exceeding 10,000 feet in places.

(*b*) The descent from the plateau to the narrow coastal plain is abrupt in the east, but more diversified in the south-east and south, the terraces being highly dissected by transverse river valleys.

(*c*) In the south and south-western Cape the Fold Mountains (trending parallel to the coast) occupy a position between the Great Escarpment of the plateau and the coast.

(3). Winds.

(*a*) In *summer* the warm moisture laiden air current of the south-east Trade Winds is drawn across the land, being gradually deflected inland, so that over the interior of the Union the winds, by now deprived of much of their moisture, sweep from the north and north-west. In the extreme west of the Union dry offshore winds predominate.

(*b*) In *winter* the conditions over the highveld and eastern Union are generally calm, although the east coast is subject to slight winds from the sea. The west and south-west regions, however, come under the influence of air currents from the north-west, and the south-west receives copious rainfall, associated with the depressions of the westerly wind belt.

(4). Precipitation.

(*a*) Fig. 1 shows that over the eastern half of the Union there is a marked concentration of rain in summer, an almost complete winter drought being characteristic. Typical "Mediterranean" conditions (hot, dry summers and mild, wet winters) prevail in the south-west. Along the south coast is a stretch of country where an average of more than 2 inches per month is received throughout the year.

(*b*) As regards the total quantity falling at any season, Fig. 2 shows that the region receiving more than 17 inches in the six summer months

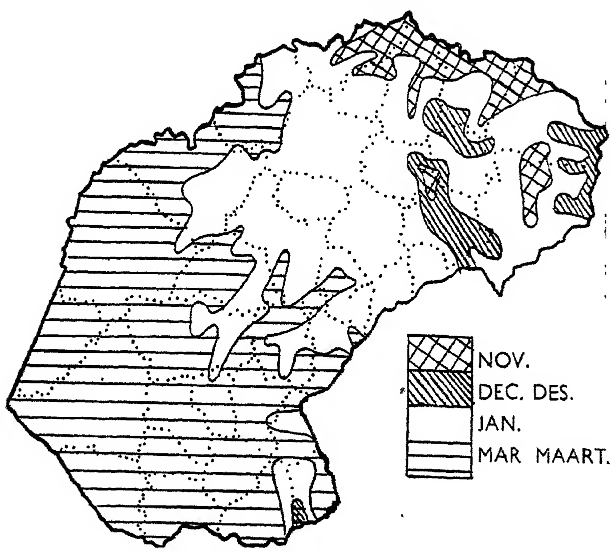

FIG. 5.—Month of maximum precipitation.

includes the major summer cereal and subtropical regions, also the major sourveld and bushveld ranching areas. In the south-western Cape as far inland as the Fold Mountain ranges, winter precipitation is adequate for the cultivation of winter cereals, and the hot, dry summers favour the ripening of grain, as well as deciduous fruit and grapes.

Along the south coast and inland along the flanks of the mountain ranges, rain can be expected at all seasons and the total quantity received is sufficient to support forest vegetation, but in the eastern Cape Province there is a marginal zone where, because of the dispersion throughout the year, the total quantity of rainfall received at any one season is insufficient for assured crop production, although it provides good year-long grazing.

In the interior and the north-west the seasonal variations in the rainfall distribution are of little practical account, since the total annual rainfall received is too small to support cultivated crops unless supplemented by irrigation.

(*c*) It can be discerned that rainfall intensity is greatest during the periods of maximum precipitation, and *vice versa*.

(d) The commencement of the summer rainy season is earliest in the east, as is illustrated by Fig. 3, and several months later in more westerly regions. The orographic influence of the Great Escarpment which lies transverse to the prevailing south-easterly winds, is dominant.

(*e*) Similarly, the duration of the rainy period, whatever the criteria adopted, shows a decline towards the west, as indicated by Fig. 4. The sudden falling off in rainfall intensity in April is very marked throughout the summer-rainfall region. The critical factor in most cases, therefore, determining the length of the rainy season, is the date of commencement of the first adequate spring rains.

(*f*) The time of occurence of maximum precipitation also shows a westward trend from month to month (see Fig. 5). The comparatively late maximum experienced over much of the summer crop-producing

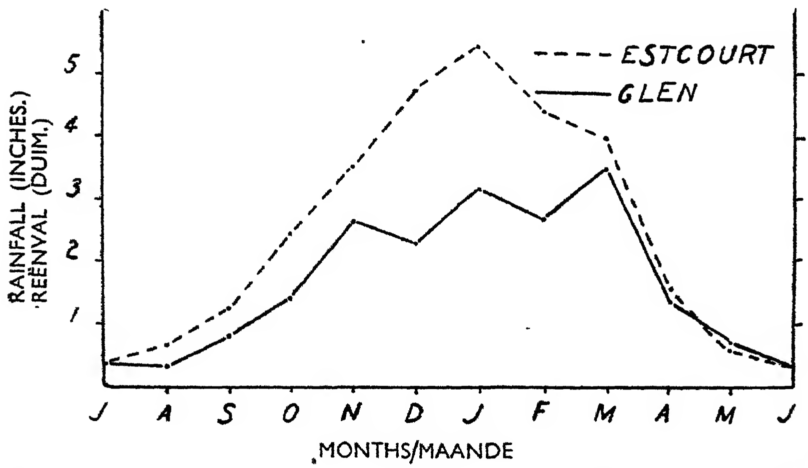

FIG. 6.—A comparison between the precipitation cycles of Estcourt and Glen ; the greater intermittency of the latter is associated with its more Westerly situation.

districts of the highveld is unfortunate, since the hazard of early frost reduces the length of the physiological growing season, even were the rainfall received adequate. Even more important from an agricultural viewpoint in regions such as the western Transvaal and central Orange Free State, is the fact that approach to the more arid west is accompanied by greater intermittency of rainfall. In other words, a single maximum is replaced by two or even three peak periods, with intervening drier, even potential drought, spells. Following the advent of the late spring rains in October-November, there is frequently a diminution until late December-January; February is very frequently a comparatively dry month, to be followed by the third and generally most reliable rainy interval in March. The two graphs in Fig. 6 illustrate this. In addition to the application of the appropriate espacement, fallowing and other cultural practices, such a study of the seasonal aspects of rainfall distribution makes it possible, in spite of the great variability of the climate, to achieve some degree of stabilization. The occurrence of intermittent summer droughts —such as frequently occur in the western marginal cropping zone—

suggests the choice of crops such as sorghums which enter a period of dormancy during dry spells and which do not suffer actual retardation to the same extent as maize. The most favourable date of planting any crop would be that which aims at coinciding the stages of critical water requirements of crops with spells of maximum—or most reliable—rainfall.

(*g*) In estimating the effectiveness of the available atmospheric moisture supply it must be considered in conjunction with the evaporating power of the atmosphere. From Fig. 7 it will be seen that over the three mid-summer months, the evaporation everywhere exceeds the precipitation, except along the eastern humid coastal area, and that the proportion increases progressively towards the north-west. Places receiving

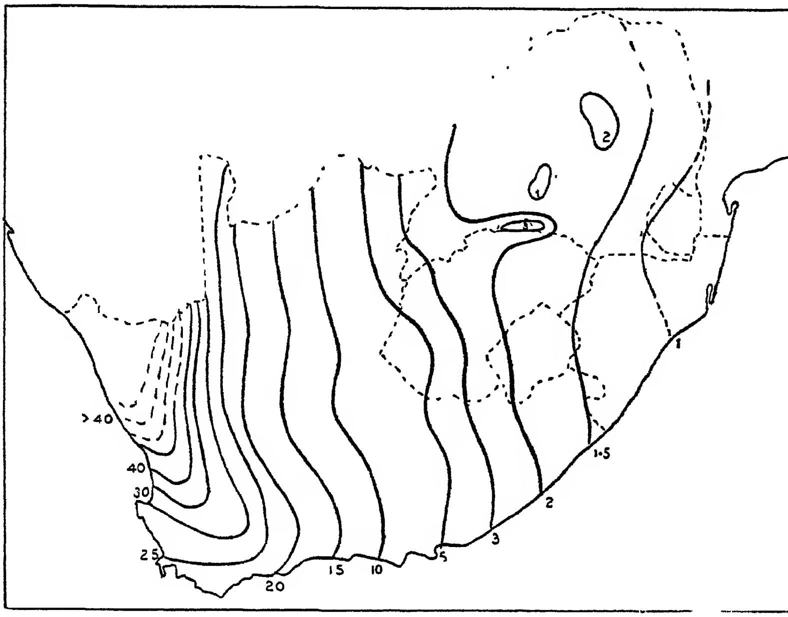

FIG. 7.—Evaporation-precipitation ratios—the average for the three summer months December, January and February.

most rainfall in the winter are in this respect better endowed than places in the summer-rainfall area, since the low evaporation rate increases the potential effectiveness of the fall; this is shown by Table I.

TABLE I.—*Winter and Summer Rainfall Seasons.*

	Winter-rainfall area. (Worcester.)	Summer-rainfall area. (Grootfontein.)
Mean annual rainfall...............	11·89″	13·57″
No. of months with >1″ precipitation	7 April–October.	6 November–April.
$\frac{\text{Evaporation}}{\text{Precipitation}}$ ratio :—		
<1	1	0
1–1·5	1	0
1·5–2	2	0
2–5	2	3
>5	1	3

(5). Temperature.

(*a*) *Altitude, Aspect and Topography.*

(1) Increase in altitude is normally associated with decrease in temperature. The lapse rate varies with the time of day, season and location, but is approximately 3·3° F. for each 1,000 feet rise. High altitudes are also associated with increased radiation, and greater daily and seasonal temperature range than corresponding lowland situations.

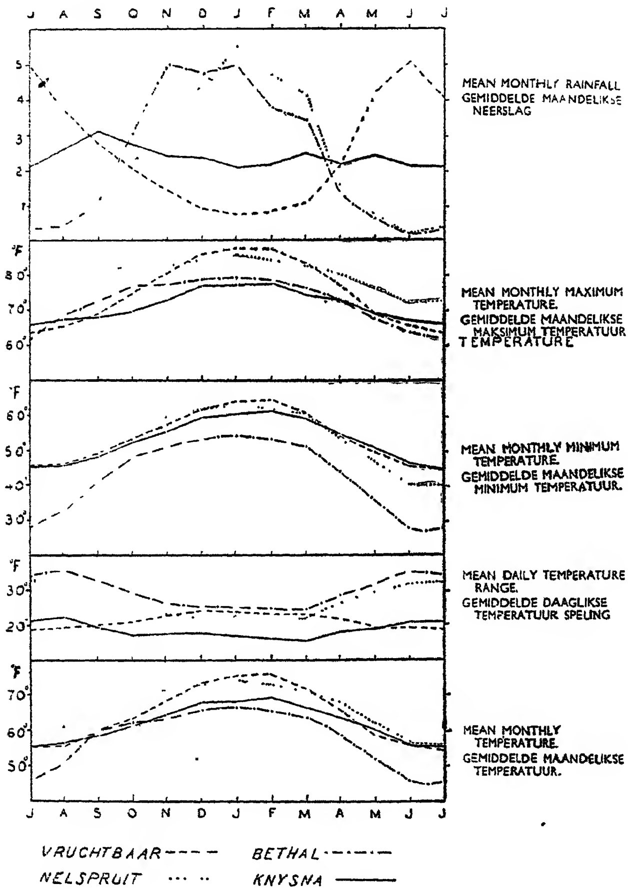

FIG. 8.—Graph showing the differences in the average monthly temperatures at five different stations, all of which receive approximately 28 in. average annual rainfall.

(2) On clear, calm, winter nights favourable for the rapid cooling of the ground by radiation, the air close to the ground may become cooler than that at higher altitudes; the normal situation is therefore replaced by "temperature inversion". Such conditions generally pertain to high altitudes and are conducive to frost.

(3) In regions of uneven surface, cold air, because of its greater density, tends to collect in the lower-lying regions which are therefore especially subject to frost and should either be avoided for cultivation or be afforded protection.

(4) North-facing slopes are generally warmer than similar south-facing slopes.

(5) West-facing slopes tend to be warmer than similar east-facing slopes.

(*b*) Latitude for latitude, temperatures along the west coast are markedly lower than those near the east coast—a fact closely correlated

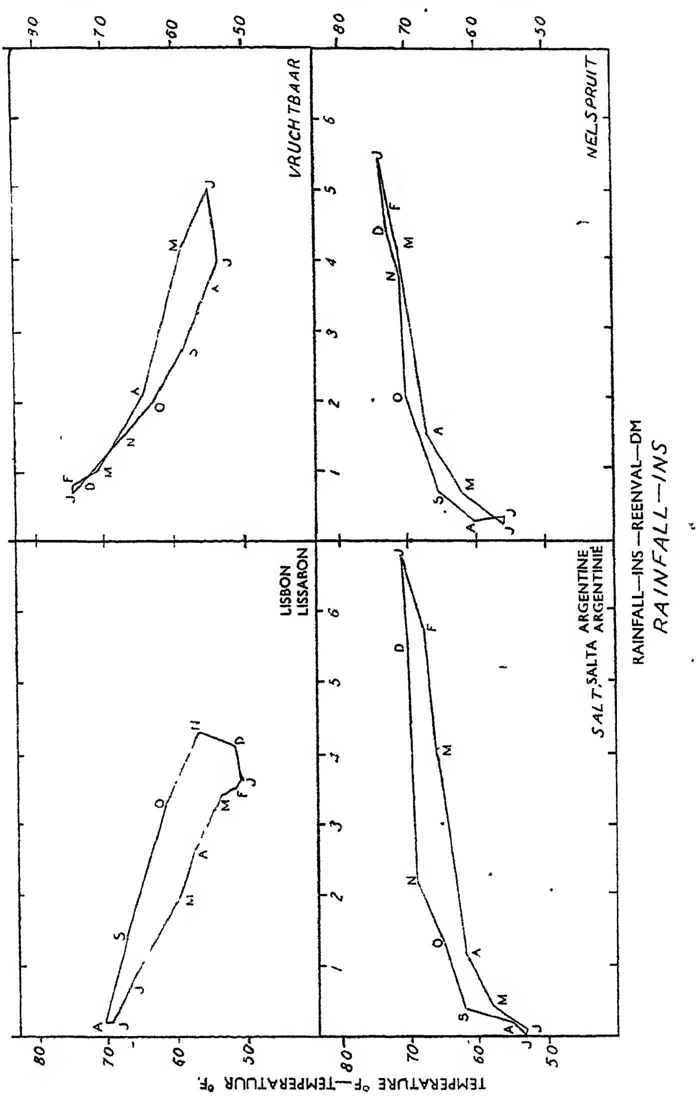

FIG. 9.—These hythergraphs show that the climate of Vruchtbaar (Wellington) markedly resembles that of Lisbon ; likewise climatic similarity exists between Nelspruit and Salta, a town in the Argentine characteristic of the Andean foothills. These diagrams do not, however, take account of other important climatic features such as length of day.

with the influence of the cold Benguella and the warm Mozambique ocean currents respectively. The following comparison (Table II) illustrates the difference:

(*c*) With respect to the north-south distribution of temperature, over much of the Union the difference is very small, as a comparison (Table III) between the following stations, 10° of latitude apart, shows.

Normally, increasing proximity to the equator is associated with rising temperature, but in the Union the rise in altitude away from the coast is a compensating factor.

TABLE II.—*Comparison of West and East Coast Temperature.*

	Latitude.	Mean Jan. temp. (°F.)	Mean July temp. (°F.)	Mean annual temp. (°F.)
Port Nolloth	29°14′	60·0°	54·6°	57·4°
Durban	29°51′	75·8°	63·3°	70·1°
Difference	—	15·8°	8·7°	12·7°

TABLE III.—*Comparison of South and North Temperature.*

	Latitude.	Mean Jan. temp. (°F.)	Mean July temp. (°F.)	Mean annual temp. (°F.)
Port Elizabeth	33°59′	69·9°	55·3°	62·5°
Pietersburg	23°54′	71·2°	51·7°	63·2°
Difference	10°5′	1·3°	3·6°	0·7°

(*d*) The further the distance from the sea, the greater becomes the range of temperature; daytime and average summer temperatures are higner than those of coastal localities, and the minimum temperatures are equally extreme.

Discussion.

From the foregoing, it will be clear that the effectiveness of any given fall of rain will vary considerably in different parts of the Union, depending on the temperature and evaporating power of the air, on the seasonal distribution, duration and intensity of the rainfall and a variety of factors at each locality. The five stations shown in Fig. 8 all receive approximately 28 inches average annual rainfall, but because of varying critical factors they are respresentative of widely differing environments. Bethal with its cool, misty summers and cold winters, its wide seasonal and diurnal temperature range, is characteristic of the high-altitude eastern Transvaal summer-rainfall regions; mountain sourveld grazing and maize cultivation are among the more important agricultural pursuits. Nelspruit shows the effect of its more lowlying situation in the high summer temperatures experienced, and the reduced temperature range; this is a centre for subtropical cultivation. The dominant aspect of the climate of Vruchtbaar (Wellington) is that of winter rainfall, the station therefore being characteristic of the south-western Cape. Knysna shows marked equability of temperature, while the rainfall is very evenly distributed throughout the year, every month receiving more than 2 inches; this dispersion of an adequate quantity of rainfall allows of forest vegetation.

The introduction of plant species and livestock breeds from regions overseas can be aided by estimating as nearly as possible the climatic counterparts in South Africa, and *vice versa*. The determination of these homoclimes (see Fig. 9) can help to ensure that the plant concerned is established in a locality that resembles its natural environment in respect of the dominant climatic features.

It has succinctly been stated that "Man has been so noisy about the way he has 'conquered Nature', and Nature has been so silent in her persistent influence over man". Where agricultural ventures have been undertaken in the past without adequate preliminary assessment of the chances of success on climatic grounds, the mistakes and failures have been costly to State and private enterprise alike. The agro-climatologist can help to give a fairly accurate estimation of the zone in which the various agricultural crops can be expected to grow successfully—provided that the appropriate cultural practices are applied and that there are no peculiar extraneous features. Such knowledge should be basic to the formulation of any future agricultural schemes, especially in respect of the intensification of marginal zones.

Importation of Livestock into the Union by Air:—

[*Continued from page* 292.

Permits for the importation of birds (including poultry) by air cannot be granted, but the Department is prepared to consider applications for permits to import by air small animals which are not subject to detention in a quarantine station, provided it is satisfied regarding the incidence of disease in the country of origin of the stock sought to be introduced, and subject to the conditions imposed by regulation or Minister's Order, and in compliance with the requirements of the Principal Veterinary Officer.

Intending consignors and introducers are warned in their own interests and in order to avoid the possible confiscation or destruction of their stock *to obtain the essential permits and all necessary information before consigning the stock to, or attempting to introduce it into the Union by land, sea or air.*

Organisations conducting air transportation services into the Union cannot accept stock for the Union unless the consignor or introducer is in possession of the necessary permit.

All enquiries and applications for permits should be addressed to the Director of Veterinary Services, Prudential House, Pretorius Street, Box 806, Pretoria. (Telegraphic Address: Privet, Pretoria.)

The Department has recently issued a temporary and abridged handbook on the subject of the introduction into the Union of stock and articles or things likely to introduce or spread stock diseases. This handbook contains extracts from the relative portions of the Diseases of Stock Acts, copies of, or extracts from the regulations and Minister's Orders, information regarding departmental and veterinary requirements, and a comprehensive index.

Copies have been sent to the appropriate departments of most foreign and other governments, to all the Union's representatives in Africa and overseas and to government operated air-lines and the various other organisations conducting charter and other air services to the Union.

Poultry Farming.

Bulletin No. 241. *Poultry Farming in S.A.* which was out of stock, has been reprinted and is again obtainable from the Editor of Publications, Pretoria.

(Price 1s. per copy, post free.)

Plant Diseases and Cultural Operations.

Dr. F. C. Loest, Plant Pathologist, Subtropical Horticultural Research Station, Nelspruit.

INCORRECT cultural practices are often the basic cause of a wide range of plant diseases in many of our horticultural and field crops. This article deals with some of these cultural mistakes and the diseases caused by or arising from them.

Seed.

(*a*) *Price of Seed.*—The price of seed is a negligible item as compared with any of the many other cultural expenses incurred in the production of a succesful crop. In spite of this, it is surprising to note how often certain farmers prefer buying seed potatoes, for instance, of uncertain origin rather than Government Certified Seed, merely because the former costs a few shillings per bag less than the latter. What one saves in the price of uncertified seed, one may well lose a thousandfold later if the seed carried " Bacterial Wilt " and infects the land in perpetuity, making it unfit for potatoes, tomatoes or any of the other crops which are subject to " Bacterial Wilt ".

" Bacterial Blight " of beans is another example of a disease commonly spread by cheap and infected seed.

(*b*) *Protection and Disinfection of Seed.*—It is not yet fully realized that markedly improved germination of pea, groundnut, cereal and many vegetable and flower seeds can be obtained by treating them with one of the many available seed protectants. In the case of the groundnut, e.g., seed treatment and consequent better germination has the further effect of reducing the incidence of a virus disease known as " Rosette "—a disease which is strikingly worse on plants within a broken stand than when the plants grow in continuous and unbroken rows.

The causal organism of " Black Rot " of the cabbage *Phytomonas campestre* (Pam.) S.A.B., is seedborne, and as this infection cannot be detected with the unaided eye, the disinfection of all cabbage seed by immersion in a solution of mercuric chloride of known strength prior to sowing should be accepted as a matter of necessity by all farmers.

Failure to disinfect seed potatoes attacked by " Scab " *Actinomyces scabies* (Thaxt.) Guss., or by " Black Scurf " *Rhizoctonia solani* Kühn, or both, by immersion in a seed disinfectant, is still often met with. These infections can easily be detected by the experienced unaided eye.

It should be pointed out that the cost of treating seeds with seed protectants and seed disinfectants is comparatively negligible.

Seedbeds.

(*a*) *Rate of sowing.*—Although it is repeatedly observed that plants on the edge of seedbeds are invariably superior in size and vigour to those inside the bed, and that disease is usually first met with on the less favourably spaced, i.e. crowded, plants, many farmers continue to sow seedbeds at too high a rate.

The way " Early Blight " *Macrosporium solani* Ell. and Mart. or " Septoria Leaf Spot " *Septoria lycopersici* Speg. attacks the over-crowded tomato plants in the middle of seedbeds more quickly than the

better spaced plants at the edge is an example of the direct contribution of over-crowding to the incidence of disease. A serious attack of "Downy Mildew" *Peronospora parasitica* (Pers.) Tul., in cabbage beds is very often due to too high a rate of sowing. It should also be remembered that the efficient control of seedbed diseases, either by dusting or spraying, is hardly possible if the stand in the bed is too thick. The use of fine sand as a dispersal medium, especially when sowing very fine seeds such as tobacco, results in a better spacing of plants in the beds. The use of maize meal for the same purpose should be avoided, as the meal may cause "damping off."

(*b*) *Levelling of seed beds.*—The failure to make seedbeds absolutely level, can result in an excessive concentration of water, at irrigation or during rain in the lowest parts, thereby causing disease which then spreads over the entire bed. Severe "damping off" diseases in tomato and papaw seedlings are good instances of diseases often found in badly levelled beds.

(*c*) *Physical Condition of seedbed soil.*—Use as light and well drained a soil as possible for seedbeds. The "Black Root Rot" *Thielavia basicola* Zopf. of tobacco seedlings, the "damping off" diseases of tobacco, tomato, papaw, and various flower seedlings, are all diseases favoured by continuously high soil moisture. These diseases are very often encountered during a wet season on heavy soil.

In general, the heavier the soil the more disappointing is the germination, although, in the case of the papaw, the most disappointing germination is often obtained in very light sandy soils. Excellent germination results have, however, repeatedly been obtained on level soil beds which have been well watered and then covered with a one-inch thick layer of fine river sand. After wetting this layer by means of a watering can or hose, the seed is sown to a depth of ½ an inch in rows spaced 4 inches apart, and then again covered with dry fine sand.

(*d*) *The Use of Compost.*—As kraal manure and artificial fertilizers are scarce, the use of compost has become very common. While this is a creditable practice, great care should be exercised because dangerous plant pathogens may be disseminated by compost made from infected materials.

As an example of diseases spread by compost made from infected plant material, the following may be mentioned, viz. "Bacterial Wilt" of the tomato, potato, chili and brinjal; "Fusarium Wilt" of the tomato, and "Black Rot" of the cabbage.

Whereas the heat developed within the heap of properly made compost is sufficient either to inactivate or to kill the causal organisms of these diseases, the real danger lies in that part of the material which is located on the outer fringes of the compost heaps.

(*e*) *Sanitation.*—Heavy losses are commonly sustained by not adopting the necessary sanitary methods. Destroy the plants in seedbeds when they are definitely no longer required, and plough over the land occupied by crops from which a remunerative yield can no longer be expected. This removes a source of infection for younger plantings in the vicinity.

Outstanding examples of insanitary practices are:— (1) The young growth on old tobacco stumps—a fruitful source of "Mosaic."; (2) old fields of beans—a dangerous source of "Rust" *Uromyces appendiculatus* (Pers.) L.K.; (3) old fields of peas—a dangerous source of "Mildew" (White Rust) *Erysiphe polygoni* D.C.; (4) old fields of cucurbits—a dangerous source of "White Rust" *Erysiphe cichoracearum* D.C. and "Red Rust" (on the cucumber) *Pseudoperonospora cubensis* B & C and "Mosaic."

Transplanting.

(*a*) *Espacement.*—Unless the rows of tomato plants, when transplanting, are sufficiently widely spaced, the plants when fully developed become so interlaced that effective control of " Septoria Leaf Spot " and " Early Blight " is not possible, and satisfactory distribution of fungicidal dusts over all plant surfaces is out of the question, resulting in appreciable losses, especially during comparatively wet seasons. The best spacing of the rows will have to be decided by each particular grower, guided by such factors as climate, rate of fertilization, natural fertility of the soil, variety of tomato, etc. It is essential that sufficient space remains between rows to allow of thorough dusting of each of the two sides of a tomato row, in the case of fully developed plants, without causing excessive breaking and bruising of the vines.

During wet seasons very appreciable losses—sometimes 50 to 75 per cent. of the crop—are often suffered by tomato growers in the eastern Transvaal, due to " Brown Rot " *Phytophthora parasitica* Dast. If sufficient space between rows has been allowed and the plants are turned over at the first sign of this disease to expose the lower fruit, which is most subject to attacks by it, very efficient control of the disease is possible by dusting with fungicides. The very common inter-row spacing of 3 feet is too narrow for the abovementioned practice. The disadvantage of turning the plants over, is that a certain percentage of the fruit is exposed to the direct rays of the sun and rendered worthless by sunscald; but this loss is small when compared with the losses which would otherwise be suffered on account of " Brown Rot ".

From observational data and the results of a single experiment, it is tentatively suggested that 4 to 6 feet between rows and 1 to 1½ feet between plants in the row should be adhered to in unstaked commercial tomato plantings.

(*b*) *Depth of Planting.*—As the lemon, grapefruit, Navel and Valencia are more susceptible to attack by " Brown Rot Gummosis " *Phytophthora citrophthora* (Sm. and Sm.) Leon., than the rough lemon stock on which they are budded, it is essential to set these trees out as high as possible when transplanting to save them from infection through the soil.

The " Crown Rot " disease *Rhizoctonia solani* Kühn of the carnation does not attack the root of the plant, but, as the name of the disease implies, only the crown. It is therefore essential to set carnation plants out as high as possible, either on level terraces or on properly contoured land, in order to have as little as possible of the stem of the plant covered with soil.

In transplanting papaw seedlings it is essential to set the plant out at the same depth which it occupied in the seeedbed. In the eastern Transvaal, deep planting, especially during late November and December when soil temperatures are high, results in a heavy attack on the green supple stem of the plant by various species of the soil fungus, Pythium. This attack leads to a total collapse of the stem at and immediately above ground level. Very severe losses of this nature are not uncommonly met with throughout the eastern Transvaal Lowveld.

When tomato seedlings are attacked by " Early Blight ", sunken brownish-black lesions are formed on the stems of the plants. This " black leg " or " swartbeentjie " is essentially a tomato-seedbed disease. If such infected plants be set out high when transplanted to the land, there is invariably a further development of the fungus, causing a collapse of the major circumference of the stem and a markedly retarded growth of the plant, resulting in the end in the death of the plant. As the infection on the stem of the tomato seedling is usually located on the lower

half of the stem, deeper planting results in the lesion being totally covered by soil, so that the lesion becomes self-limited and a new root system is formed on the stem above the lesion, resulting in a complete rehabilitation of the plant. Efficient earthing up of tomato plants when this disease is first noticed on transplants, is the best approach to the control of the disease on the land. The latter statement does not, of course, attempt to encourage the production of diseased plants in seed-beds.

(*c*) *Out-of-Season Planting.*—As there exists no organized system of distribution of vegetable products to the various markets throughout the Union, and as the price of these products is not controlled, the net figure realized by farmers on the markets is largely determined by the factors of supply and demand. This results in an ever increasing tendency for farmers to produce a certain volume of their crops during the out-of-season period when the supply of these products on the markets is at its lowest. In spite of the reduced crops realized by this out-of-season production, the average price level obtained often amply compensates for this reduction, resulting in a continuance of the practice.

In the Transvaal Lowveld, where disease is most rife, this out-of-season production is leading to an accumulation of soil-borne diseases and parasitic nematodes which flourish under the conditions in which the out-of-season crops are grown. Not only does this accumulation of diseases hamper the further remunerative production of out-of-season crops, but also markedly reduces successful production of such crops in the right season. Outstanding examples of diseases accumulating in the Transvaal Lowveld, largely through planting out-of-season, are:

"Bacterial Wilt" of the potato and tomato; "Fusarium Wilt" of the tomato; "Black Rot" of the cabbage; "Bacterial Blight" of the bean, and "Fausarium Wilt" of the pea and cucurbit.

Injuries to Plants.

(*a*) *Mechanical.*—Mechanical injury sustained by citrus fruit is the main contributing condition to the incidence of the folowing diseases viz. "Green mould" *Penicillium digitatum* Sacc., "Blue mould" *Penicillium italicum* Wehmer, and "Sour rot" *Oospora Citri-aurantii* Ferraris. These diseases account for the major citrus fruit-wastage losses in South Africa. These losses are still appreciable.

Attacks of "Anthracnose ripe rot" *Gloeosporium Papayae* P. Henn, and "Soft rot" *Rhizopus nigricans* Ehr. of papaw fruit, both follow readily on any mechanical injury sustained by the fruit. It is advisable therefore to place woodwool at the base of lug boxes in order to reduce the chances of mechanical injury to the rind of papaws.

In digging or ploughing up sweet potatoes, a certain percentage of the tubers is almost unavoidably broken or cut. The later should be sorted out and kept apart from the sound tubers because "storage rot", caused by the fungi *Rhizopus nigricans* Ehr., *Phythium ultimum* Trow. and a *Fusarium* sp., soon develop in the injured tubers and result in the infection of sound tubers both in storage and in transit.

(*b*) *Climatic.*—After severe hail or frost damage, papaw trees are often heavily attacked by "Anthracnose Stem Rot" *Gloeosporium Papayae* P. Henn., resulting in the toppling over of the trunk at the worst lesion or lesions. Severe losses have been experienced. This disease is particularly severe on trees which were already lacking in the necessary vegetative vigour prior to the frost or hail damage. If trees, when damaged by frost or hail, are at once judiciously irrigated and well fertilized, chiefly in respect of sufficient easily available nitrogen, the disease will cause very little damage to the trunks. Any of the following

[*Continued on page* 324.

The Blue-Leafed Spineless Cactus Varieties.

SPINELESS Cactus, as a drought resistant fodder for stock, has in past years played an important rôle in many of the drier areas of the Union. With the introduction of the cactoblastis and the cochineal parasites, spineless cactus in the Karroo is steadily being eradicated in addition to the wild types, and its loss is worrying farmers, who have placed reliance on it as a standby during drought.

The only ray of hope on the farmer's horizon would appear to be the existence of a very limited number varieties of spineless cactus which at the moment appear to be highly resistant to cochineal, and which cactoblastis does not affect very seriously. These are the so called blue-leafed varieties known as *Monterey, Robusta* and *Chico*, which are gaining prominence in the Middelburg and adjoining districts, and which are being effectively utilised by farmers, despite certain seemingly unfavourable characteristics which these varieties possess.

Of twenty-seven spineless cactus varieties planted out at Grootfontein in 1938, practically the only varieties still standing are the three varieties referred to above. In appearance the blue-leafed varieties look very similar. All possess large round blood-red fruit. On close examination, however, it can be observed that in the case of Monterey and Robusta, although almost identical in the shape of the leaf, the latter variety is almost entirely spineless, whilst Monterey possesses a few large spines on the edge of the leaves. Chico, on the other hand, has a smaller and less round leaf than the other two varieties, has a bluer colour, and definitely possesses more spines on the leaf edges.

In variety and palatability trials in the Karroo, the blue-leafed varieties are found to be slower growing, lower yielding and definitely less palatable than the ordinary green-leafed varieties. Owing to its spines and poorer palatability when grazed, Chico could not be recommended in preference to Monterey and Robusta.

The lack of palatability is a relative term, and it is the experience of farmers that animals will eat the blue-leafed varieties when other varieties are not available. Furthermore, it would appear that the lower palatability of these varieties cause animals to eat less, with less attendant scouring. The value of Monterey as grazing during drought can be indicated by the experience of one Middelburg farmer. On a 70 morgen patch of Monterey planted in the veld in September 1944, he carried during last year's drought, sixteen mules from May to the end of October, twenty head of cattle from the middle of August to December, and six hundred sheep from September to the beginning of December. Despite the poorness of the veld between the cactus, the cattle improved in condition and the sheep did well. With the mules introduced first, confining their attention to the veld, this limited the amount available for the cattle and sheep later.

Unless the cochineal parasite eventually develops a strain that will destroy the blue-leafed varieties, it would appear that Monterey and Robusta particularly can still play a part in the Karroo.

Should farmers consider the establishment of one or another of these varieties next spring, sufficient time is available to contact people who can supply leaves. The Grootfontein College of Agriculture is not in a position to supply, and as large plantations are known to occur in the Middelburg district, it is suggested that contacts could be made through the Secretary of the Middelburg Farmers' Association.

(D. W. McKellar, Senior Professional Officer, Grootfontein College of Agriculture, Middelburg, Cape.)

The International Egg-Laying Champion.

P. H. C. du Plessis, (Lecturer in Poultry) Institute of Agricultural Research, Natal University College, Pietermaritzburg.

THE extraordinary achievement in the Nineteenth Central Egg-laying Competition of 1944/45 at the Agricultural College, Glen, of the Black Australorp hen No. 215 in laying 354, A eggs and 1 B egg in 365 days

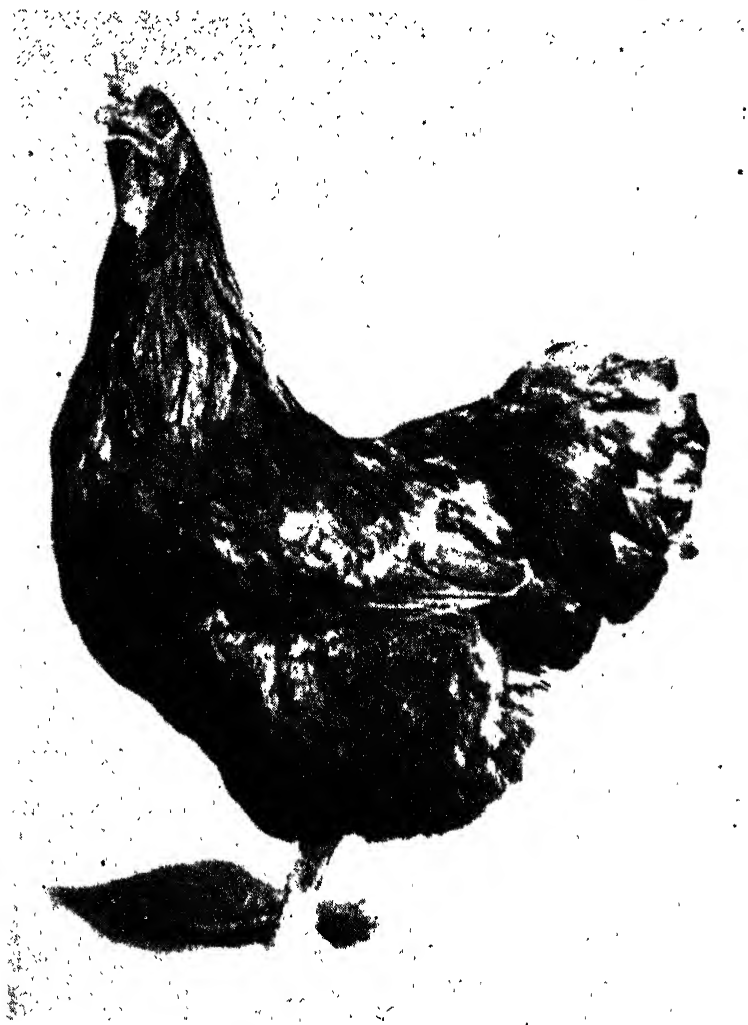

FIG. 1.—**The World Champion.** This Australorp hen (No. 215), with a production of 354 A and 1 B eggs, won for South Africa the highest distinction.

was so phenomenal that several poultry experts were convinced that this undoubtedly constituted a world record. The South African record of

336 A eggs in 365 days established in 1929/30 also by an Australorp hen, was beaten by no less than 18 eggs, and 1 B egg.

(An A egg weighs 2 oz. and more; and a B egg less than 2 oz.)

Immediately after this historic Egg-laying Competition, the writer set himself the task of collecting all the comparative figures of similar competitions throughout the world in order to establish whether this record by hen No. 215 might be justly regarded as a world record or not.

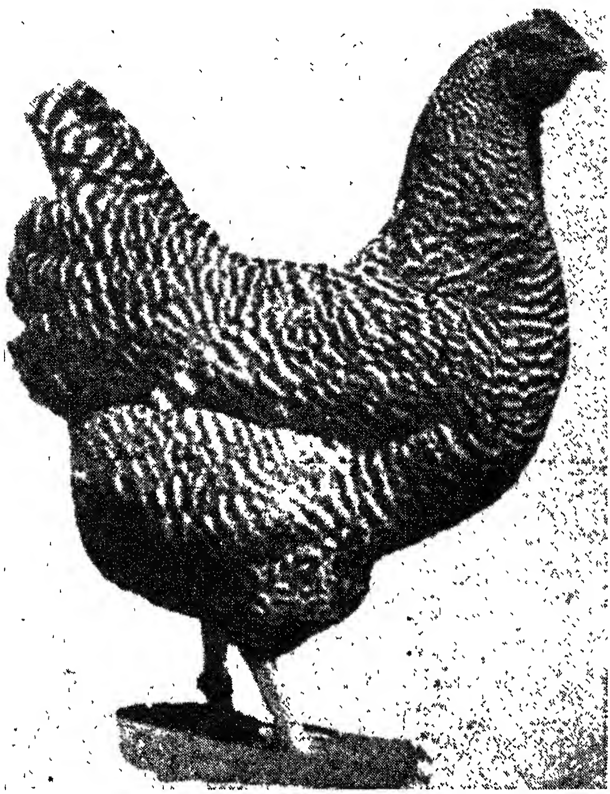

Fig. 2.—Barred Rock "Lady Victorine" owned by the University of Saskatchewan.

The press, too, gave special prominence at the time to this topic, partly to invite discussion and partly to gain all available information. Very soon our attention was drawn by one of our most prominent poultry farmers to the following news item which appeared in the *South African Poultry Magazine* of February 1930. "In addition to a world's record for 10 hens of any breed established in 1927 by 10 Barred Rock hens with 2,807 eggs at the Puyallup Egg-laying Test, an individual world's egg-laying record has just been officially confirmed where Barred Rock hen No. 440, "Lady Victorine" (Fig. 2) has smashed existing 300 and over notches by laying 358 eggs in 365 days and all eggs were over 2 oz. This hen is the property of the University of Saskatchewan, Canada. The writer's hopes for the South African hen were frustrated by this amazing performance of the Canadian hen. Nevertheless, the University of Saskatchewan was approached for confirmation and Prof. W. J. Rae of that University's Division of Poultry Breeding replied saying that they were delighted at our interest in their hen No. 440, more generally known

as "Lady Victorine". He said that her production of 358 eggs was at the time regarded as a world record but that the report in our journal was not quite accurate, as all her eggs did not weigh over 2 oz. He pointed out that it is common knowledge that at the onset of egg production the eggs are always lighter than later on in the season. From what Prof. Rae says further, the production of hen No. 440 was not officially recognized since this performance was not achieved at an official egg-laying competition, but at a private test conducted by the poultry section of the University. This performance is none the less remakable in that it was

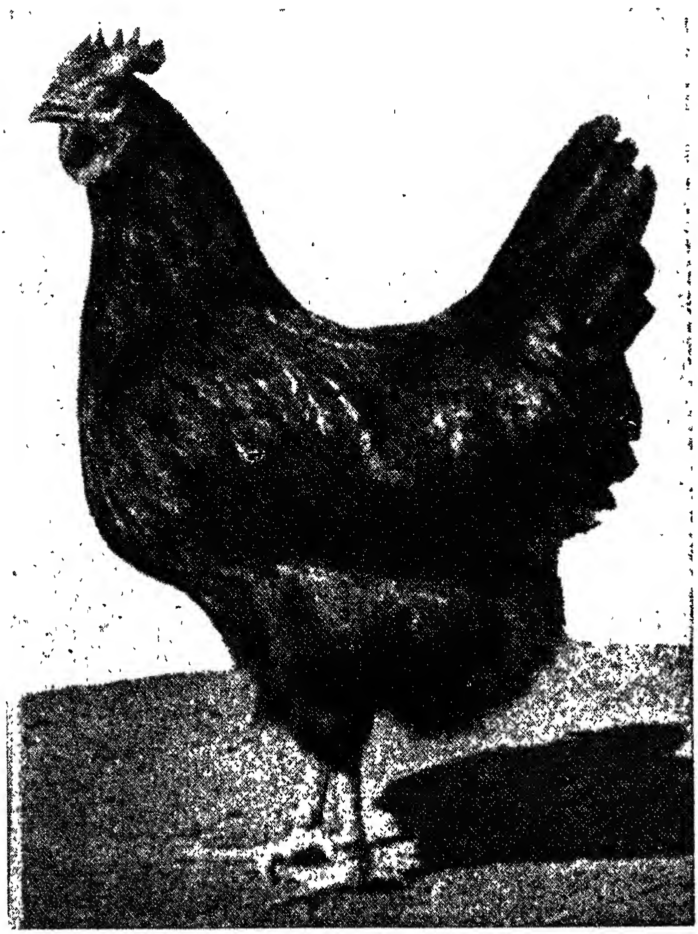

Fig. 3.—Holder of record in Australia in laying 340 first-grade eggs in 365 days. A Particularly fine type of Australorp hen.

made in a very cold region where temperatures fall to 39° F. below freezing point, and particularly in view of the fact that "Lady Victorine" did not lay the first egg until she was 192 days old.

The study of the data of egg-laying competitions in different parts of the world is made extremely difficult by the fact that comparison is almost impossible as the results are not recorded in the same way. England, Australia and South Africa adopt more or less the same method.

Individual egg weight is registered and eggs below a certain weight do not count for record purposes. The duration of the test is also the same, viz., 336 days. In the United States of America an entirely different basis is adopted. There, points per egg are allotted and individual egg weight, as such, is not considered. The points are assessed as follows:—

TABLE I.—*Allocation of points in U.S.A.*

Ounces per doz. eggs—	*Points Allotted per Egg.*	Ounces per doz. eggs—	*Points Allotted per Egg.*
18	0·70	23	0·95
19	0·75	24	1·00
20	0·80	25	1·05
21	0·85	26	1·10
22	0·90		

In Canada the hen's merits are determined in ounces per dozen eggs. The duration of the test in both countries is 357 days. According to details furnished by the Director of the Board of Scientific and Industrial Research, Melbourne, it would appear that the existing Australian egg-laying record is 340 first-grade eggs in 365 days. A Black Australorp hen

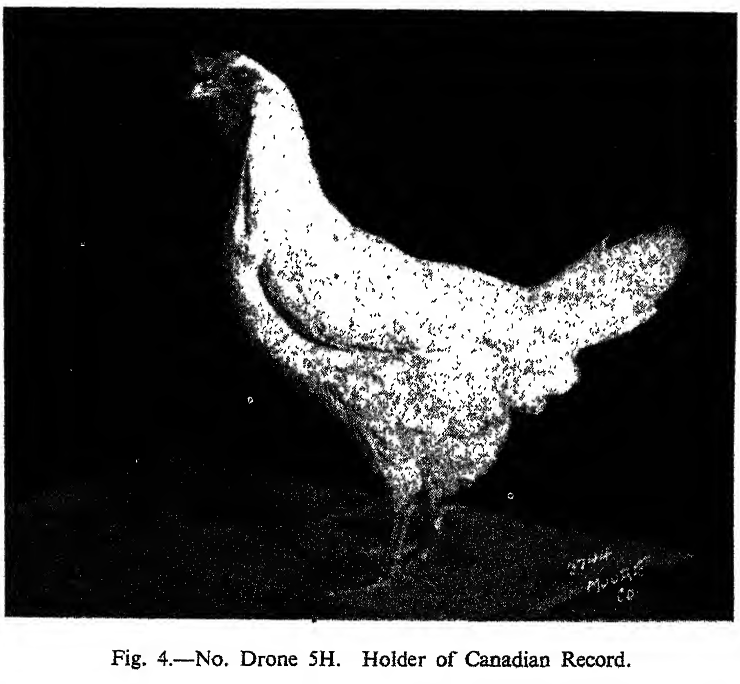

Fig. 4.—No. Drone 5H. Holder of Canadian Record.

competition. (Fig. 3.) This breed it to day the most popular, in Australia and New Zealand. White Leghorn hen, No. Drone 5H (Fig. 4) holds the Canadian record. This hen laid 357 eggs in 365 days—an amazing performance. Unfortunately, the weight is that of eggs per dozen and consequently there is no indication of the number of eggs weighing less than 2 oz. A striking feature it that several other very high records have been attained in that country as is clearly evidenced by table II.

It is noteworthy that the egg weight in general is low.

The Barred Plymouth Rock is the most popular breed in Canada and from the foregoing it is also clear that exceptional progress has been made in the breeding of Plymouth Rock for high egg production.

TABLE II.—*Canadian Records.*

Breed.	Hen No.	Production for 365 Days.	Egg Weight (oz. per doz.)	Egg-laying Competition.
White Leghorn	G. 6856	340	24·3	1946–47
White Leghorn	6	351	?	?
Rhode Island Red	G. 30609	350	24·8	1946–47
Barred Plymouth Rock	G. 42073	356	23·7	1946–47
Barred Plymouth Rock	G. 41959	349	24·2	1946–47
Barred Plymouth Rock	G. 42020	352	23·3	1946–47
Barred Plymouth Rock	D. 25447	346	26.2	1944–45
Rhode Island Red	D. 33155	346	23·9	1944–45
Barred Plymouth Rock	A. 25825	341	24·8	1941–42
Barred Plymouth Rock	C. 31656	354	24·7	1943–44

Fig. 5.—Rhode Island Red hen No. 4. The egg laying machine of the United States with the outstanding production of 358 eggs in 365 days. All the eggs did not weight 2 ozs. This production was established in the New York egg-laying Competition 1942/1943.

Of all the countries in the world, the U.S.A. seems to be in a position to supply the most exhaustive data in connection with their egg-laying competitions. The publication "Who's Who in U.S.A. Egg-laying Tests" is most useful and furnishes *inter alia* full particulars in regard to any achievement in American egg-laying competitions.

Other useful information is also furnished in summarized form. Prof. R. George Japp of Ohio University and Mr. C. S. Platt, Secretary of the Board of American Official Egg-laying Competitions, have been at pains to give useful information in this connection.

As may be seen from the following table the Rhode Island Red and the White Leghorn are at present Champion egg producers in the American Egg-laying competitions.

TABLE III.—*Twenty-five of the highest producers since the inauguration of the Egg-laying Competitions in the United States.*

Egg-Competition.	Hen No.	Breed.	Eggs Produced During 51 Weeks.	Points Obtained.
1943	45	Rhode Island Red	351	386·10
1946	18–9	Rhode Island Red	343	376·85
1945	39–8	Rhode Island Red	343	375·20
1941	2–12	White Leghorn	343	376·25
1944	40–1	Rhode Island Red	342	376·05
1941	24–6	White Leghorn	340	373·35
1939	79–13	White Leghorn	340	372·30
1945	17–9	Rhode Island Red	343	372·25
1944	2–10	White Leghorn	342	371·85
1942	29–1	Rhode Island Red	338	371·55
1945	68–12	White Leghorn	344	371·35
1945	77–12	White Leghorn	344	371·25
1943	9	New Hampshire	339	371.00
1937	7–17	White Leghorn	345	370·65
1938	43–9	Rhode Island Red	341	369·55
1946	8–8	Rhode Island Red	336	369·05
1940	97–5	White Leghorn	343	368·95
1940	1–9	Rhode Island Red	340	368·95
1938	24–20	Rhode Island Red	341	368·85
1944	9–6	Barred Plymouth Rock	338	368·85
1945	21–5	White Leghorn	343	368·80
1942	97–11	White Leghorn	347	368·15
1933	5–20	White Leghorn	338	367·25
1940	5–5	White Leghorn	345	367·10
1945	39–7	Rhode Island Red	336	366·50

It would appear as if the individual production recorded for the last ten years is much higher than before. The achievement of laying more than 300 eggs is to-day common. It is, of course, doubtful whether the average, as such, has improved. The present American record is held by a Rhode Island Red hen (No. 45 Table 3 and Fig. 5), with a production of 358 eggs in 365 days and an aggregate of 393·80 points. Superfiially, it would appear that all the eggs must have weighed more than 2 oz. each to gain a total of 393·80 points. (One point per egg is accredited when eggs weigh 24 oz. per doz.) This is not necessarily the case, and the chances are that some weighed less then 2 oz. The aggregate 393·80 gives precisely 26 oz. per doz. Consequently, it is quite possible that at the beginning of the competition some of the eggs weighed less than 2 oz. The body weight of this hen was 6·3 lb. and her best cycle was 184 eggs (i.e., eggs laid on successive days.)

Information from Great Britain as supplied by the Commonwealth Relations Office, gives the maximum production attained as 318 eggs in

336 days. This was established by a Rhode Island Red in 1931/32 and was equalled by a White Wyandotte in 1934/35. It would appear that outstanding individual performances are not common in Great Britain and it is most likely this aspect of the matter was much neglected during the recent war years.

According to the "Commonwealth Relations Office", the "National Farmers' Union" affirms that, according to information at its disposal, the International Egg-laying record is held by a South African Black Australorp hen, No. 215. After a careful analysis of all available information, it is undoubtedly the only logical conclusion to be reached, especially from the point of view of egg weight. She is certainly not the champion in so far as the total number of eggs is concerned, being surpassed in this respect by many hens. Her performance is phenomenal and it is doubtful if it will ever be equalled or surpassed. She laid 167 eggs without a break, i.e. she laid one egg every day for 167 successive days. [The Canadian White Leghorn No. 6 (Table II) holds the world record for the longest cycle, viz., 213 eggs.] At the end of the 365 days test, hen No. 215 weighed 6 lb. Her weight increased by 11 ounces from the time the competition commenced. She began the competition by laying 2 oz. eggs and ended by laying eggs weighing $2^7/_{16}$ oz.

The comparison between the egg productions of the American Champion, hen No. 45, and the South African Champion, hen No. 215, is extremely difficult as the results were recorded in a different manner. All the eggs of hen No. 215, were weighed and 354 weighed 2 ounces and over. In the case of hen No. 45, however, only one egg was weighed per week and the total score calculated therefrom, which amounted to 26 ounces per doz. (393·8 points). It is common knowledge, however that a pullet at the start of her laying season may produce a large percentage of eggs weighing less than 2 oz. as was also pointed out by Prof. Rae, in the case of "Lady Victorine". The total weight of eggs calculated for the American hen No. 45, is, therefore, merely a theoretical figure and certainly not comparable with a performance based on the weight of every egg produced. We therefore have no hesitation in declaring hen No. 215 as the International Egg-Laying Champion.

The pity of the matter is that the fame of No. 215 should cease at this point. In the U.S.A., especially during recent years, special attention has been given in Egg-laying competitions to the question of progeny tests. In the Western N.Y. Egg-laying Competition of 1944/45, 13 White Leghorn sisters achieved the amazing average production of 321·1 eggs per hen in 357 days, the highest individual production being 343 eggs. This is a record of which the Americans can be justly proud as such progeny tests are the basis of any progressive breeding programme, but in South Africa it does not as yet receive any prominence in Egg-laying Competitions. The time has surely come for the various organisations that have the poultry industry at heart to see to it that this serious flaw is remedied and it is to be hoped that the incentive and encouragement will be given to breeders to follow up such performances as that of No. 215, with tests and records of her progeny.

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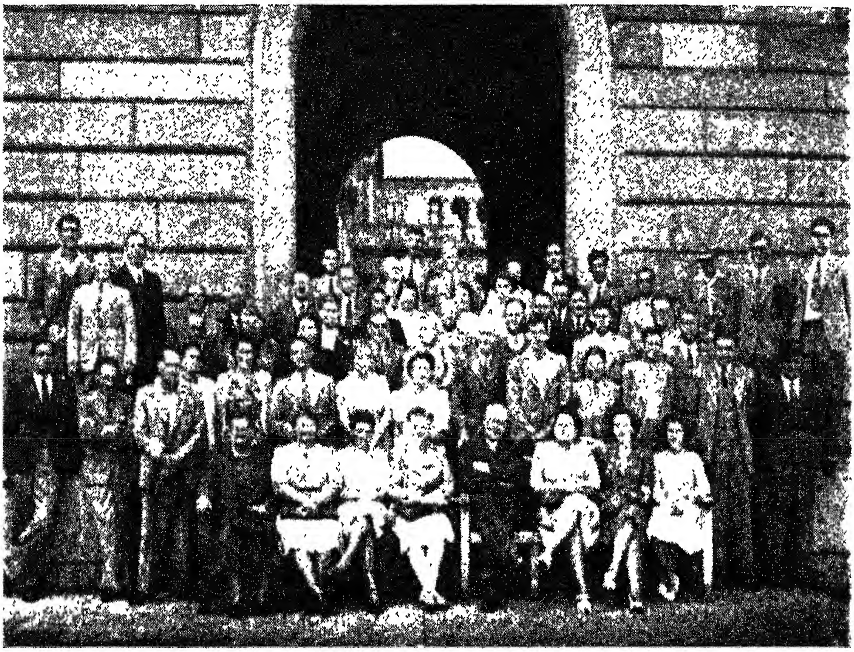
Increased Interest in Beekeeping.

In spite of the great difficulty beekeepers are experiencing in getting good beekeeping equipment as an aftermath of the war, the interest in the possibilities of apiculture in the Union is steadily increasing.



Short Course in Beekeeping. Pretoria, March 30 to April 2, 1948.

The following table indicates the very good attendance at the short courses given by Dr. A. E. Lundie, Apiculturist of the Division of Entomology, during the past five years, where five hundred and fifty-six persons received special tuition in modern beekeeping methods.

Place.	Date.	Attendance.
Pretoria	September 1943	50
Pretoria	April 1944	46
Cape Town	January 1945	43
Stellenbosch	January 1945	17
Pretoria	April 1945	86
Potchefstroom	November 1945	29
Pretoria	April 1946	58
Potchefstroom	November 1946	26
Cape Town	January 1947	31
Pretoria	April 1947	43
Potchefstroom	November 1947	44
Cape Town	January 1948	26
Pretoria	March/April 1948	57
		556

Fifty-seven persons attended the recent short course held at Pretoria from March 30 to April 2. The photograph was taken at the Union Buildings where the lectures were given. The demonstrations were held in the Departmental Apiary nearby.

The Composition and Use of Karoo Manure.

11. Value of Karoo Manure as a Source of Plantfood.

Dr. E. R. Orchard and R. Ludorf, Division of Chemical Services, Pretoria.

THE first past of this article, which appeared in the April 1948 issue of this journal, dealt with the production, distribution and composition of Karoo Manure, while the present article deals with the value of Karoo manure in relation to kraal manure, compost, etc.

During World War II the price of fertilizers rose steadily, and by 1946 prices had in practically all cases been doubled.

The price of Karoo manure also increased, but not to the same extent; the price (f.o.r.) of the unbagged crude manure was fixed again in 1946 at 14s. per ton and for milled manure at 30s. per ton.

It is, therefore, of interest to apply the present-day unit costs of plantfoods in standard commercial fertilizers to Karoo manure in order to form an opinion whether or not the farmer who pays the fixed price is receiving good value for his money.

In Table VII (*a*) the unit prices for three standard fertilizers are given, i.e. the price per ton of the fertilizer, divided by the percentage of N, P_2O_5 or K_2O which it contains. The unit price therefore represents the cost of 20 lb. of plantfood expressed as N, P_2O_5 or K_2O.

TABLE VII (*a*).—*Unit Price of N, P_2O_5 and K_2O in Fertilizers.*

	1939.	1941.	1946.
Sulphate of Ammonia (N)	8s. 6d.	15s. 9d.	19s. 0d.
Superphosphate (P_2O_5)	4s. 4d.	6s. 11d.	7s. 6d.
Muriate of Potash (K_2O)	3s. 7d.	5s. 11d.	7s. 6d.

By taking the average composition found for all samples analysed (Table V—see previous journal) and evaluating the manure on the same basis shown in Table VII (*a*) above, we have the following:—

TABLE VII (*b*).—*Value of Plantfoods in one Ton of Absolutely Dry Karoo Manure.*

Mean of 332 Samples.	1939.	1941.	1946.
1·68 per cent. N	14s. 3d.	26s. 6d.	31s. 11d.
1·09 per cent. P_2O_5	4s. 9d.	7s. 6d.	8s. 2d.
4·92 per cent. K_2O	17s. 7d.	29s. 1d.	36s. 11d.
Add value of organic matter—say 5s.	5s. 0d.	5s. 0d.	5s. 0d.
TOTAL	41s. 7d.	68s. 1d.	82s. 0d.
Reduce value to adjust for moisture content—			
Crude manure (37·7 per cent. moisture)	25s. 11d.	42s. 5d.	51s. 1d.
Milled manure (23·4 per cent moisture)	31s. 10d.	52s. 2d.	62s. 10d.

In arriving at the values shown in the last two lines of Table VII (*b*), a number of assumptions have necessarily been made, the most important being that the plantfood constituents of manure are as available to crops and therefore as valuable as the plantfoods in commercial fertilizers. This is by no means correct, particularly in the case of nitrogen and phosphate. These plantfoods are mineralised to become available for plants as the manure decomposes in the soil, hence the extended action or residual effect of manure as compared with the mineral fertilizers which generally are quicker to act. On the other hand, many agriculturists maintain that organic manures are more valuable than fertilizers for this very reason. Moreover, potash accounts for nearly half the total value of the plantfoods when the manure is assessed in the manner shown, and it has already been suggested that potash is frequently wasted when applied indiscriminately to South African soils. The farmer wishing to apply N and P_2O_5, however, has no option in the matter of K_2O. It should also be kept in mind that in transporting, handling and distributing manures, the cost per morgen is usually greater than for concentrated artificial fertilizers on account of their bulk and unsuitabality for mechanical distribution.

In view of these disadvantages which are inseparably associated with the use of manure, it would therefore not be unreasonable to assess the true agricultural worth at only about one-third to one-half the value shown in the last two lines of Table VII (*b*).

If the factor of one-third to one-half, as suggested, is accepted as reasonable and is applied to the final figures in Table VII (*b*), it will be seen that by the time the manure has been transported and applied, the farmer buying milled manure is paying far more than the full price for value received, whereas the user of crude manure has paid approximately the actual value and, therefore, has much the better bargain. There is little doubt that crude Karoo manure is to-day, even at 14s. per ton, still the cheapest source of fertility to be found on the market.

From an agricultural point of view there is little, if any, justification for the unduly high price some farmers are prepared to pay for the milled product, in spite of its easier handling and distribution. Taking both price and moisture content into consideration, the farmer who buys the crude product receives 75 per cent. more "fertility" for the same money.

Although absolutely reliable figures are not available, enquiry has shown that milled manure represents about one-third to one-quarter of the total tonnage of Karoo manure sold annually. The western Cape Province farmers wisely buy practically all their manure in the crude form, while the milled product is favoured by maize and wheat farmers who apply it through ordinary fertilizer distributing machines. By this method a maximum of about 800 lb. of milled manure can be applied per morgen; this dressing contains less than 8 lb. of P_2O_5 which is equivalent to about 50 lb. superphosphate. As maize has been shown to respond mainly to phosphate (200-400 lb. super per morgen), it is obvious that unless the milled manure dressing is supplemented with phosphatic fertilizer, it is quite inadequate for the purpose. These remarks apply equally to milled compost of which a large tonnage is sold annually.

Fertility Applied Annually as Karoo and Kraal Manure.

In order to form an idea of the relative importance of these manures as a source of fertility for our soils, the following table has been constructed which shows the quantities of N, P_2O_5 and K_2O applied as manure in relation to the country's annual fertilizer requirements.

Applying the mean values of Table V to the 1946 tonnage shown in Table II and assuming that 75 per cent. of Karoo manure is sold in the

crude form and 25 per cent. in the milled form, we have:—

	N.	P_2O_5.	K_2O.
	Tons.	Tons.	Tons.
NPK in 258,750 tons crude Karoo manure (161,201 tons dry mat.)	2,708	1,757	7,931
NPK in 86,250 tons milled Karoo manure (66,068 tons dry mat.)	1,110	720	3,250
NPK in 108,000 tons Kraal manure* (76,040 tons dry mat.)	1,384	479	2,608
(A) Total NPK in Kraal and Karoo manure (1946)	5,202	2,956	13,789
(B) Total NPK required annually in the form of inorganic fertilizers 1946)	7,000	68,400	5,000
(C) Total (A) and (B) ...	12,202	71,356	18.789
(A) Expressed as a percentage o (C)	42·7	4·1	73·4

* See Tables I and IX.

The plantfoods shown against (A) above, when expressed in terms of fertilizers, are equivalent to 26,000 tons of sulphate of ammonia (20 per cent. N), 18,000 tons superphosphate (17·1 per cent. P_2O_5) and 23,000 tons muriate of potash (60 per cent. K_2O), and in conjunction with all this fertility, a total of 155,000 tons of organic matter is added to our soils annually.

The trade in organic manures therefore contributes a very considerable proportion of the plantfoods used annually throughout the Union. The P_2O_5 contribution is relatively small, but there is every reason for using the large amount of the more valuable nitrogen constituent to the best possible advantage while the supply of manure is still good. It is difficult to predict when the supply will decline, but there is little doubt that at the present rate of exploitation, production must drop in the near future as most of the manure sold to-day is not from current production, but represents the accumulations of many years in old kraals. As production drops, so the price is bound to increase and this will ultimately force fruit and vegetable farmers to find alternative sources for the fertility which they require. In the United States, sheep manure is no longer available for sale in significant quantities and the price has risen to such an extent that it is to-day by far the most expensive form in which nitrogen and phosphate can be bought. In Texas, the cost per lb. of N and P_2O_5 in 1945 was 9·0 and 5·80 cents when bought as ammonium nitrate and superphosphate respectively, but in the form of sheep manure the cost per lb. was 68 cents for nitrogen and 36·5 cents for P_2O_5, so that the price of the manure is prohibitive for ordinary farming purposes.

Kraal Manure, Farm Compost, Municipal Compost and Karoo-Manure Ash.

The war-time fertilizer scarcity stimulated interest in all possible alternative sources of fertility. The Department of Agriculture encouraged the conversion of agricultural waste materials produced on farms into compost, while many municipalities throughout the Union established compost factories using all types of town refuse as raw material. As a result of this activity a considerable number of compost samples was

submitted for analysis from time to time by farmers, municipalities, traders and officials. Although exact details of manufacture are not known in many cases, the samples were grouped into two main types and the data presented under Farm and Municipal compost respectively.

The analytical data presented in respect of kraal manure are derived from samples submitted for analysis by farmers and traders from time to time; they may be regarded as fairly representative of the manures produced in the ranching districts of the Transvaal.

In the same way the figures presented for Karoo-manure ash and goat manure may be regarded as random samples drawn from the trade.

With the possible exception of farm compost, the number of samples in each group is relatively small, so that the data are not as reliable or representative as is the case for Karoo manure; the information is nevertheless included in this article for the sake of interest, as the data are probably more complete than any published hitherto on this country.

Transvaal Kraal Manure.—During the war the trade in kraal manure (cattle manure) also expanded considerably, particularly in the Transvaal (ref. Tables I and IV). The manure is used chiefly in the vegetable and fruit-growing districts of Letaba and Nelspruit.

The data in Table IX are derived from a total of 29 samples.

TABLE IX.—*Kraal Manure (29 Samples).*

	Moisture.	Loss on Ignition.	Total N.	P_2O_5.	K_2O.
	%	%	%	%	%
Minimum	8·5	34·3	0·96	0·27	1·69
Maximum	48·5	66·8	2·59	1·18	6·93
Mean	29·6	48·6	1·82	0·63	3·43

Expressed on the oven-dry basis.

Kraal manure is slightly richer in nitrogen but poorer in potash than Karoo manure; the main difference, however, lies in the phosphate content; the P_2O_5 in kraal manure barely reaches 60 per cent. of that found in Karoo manure. The average ratio between N and P_2O_5 of 2:9 for Karoo manure is nearly double that of kraal manure (1:5), so that in order to derive the full benefit from its valuable nitrogen, it is advisable to use even larger supplementary dressings of phosphatic fertilizer with kraal manure than with Karoo manure. It is generally recognised that kraal manure contains less "brak" salts than Karoo manure, so that there is less danger of "burning" sensitive crops or of causing excessive salt accumulations in the soil.

The principal districts supplying kraal manure for sale are Rustenburg and Waterberg.

Farm Compost.—As a considerable number of samples were analysed; the data are more reliable and therefore given in greater detail. Of the 80 samples examined, 70 came from the irrigation settlements: Vaalhartz, 29; Upington, 20; Brits, 16; Hartebeespoort, 5. As details of manufacture were not always available, all farm composts were grouped together irrespective of the nature of raw materials, method of composting, period of decomposition, etc. In some cases it was obvious from the analysis that considerable quantities of phosphatic fertilizers and manure had been used in the heaps to assist decomposition.

TABLE X.—*Farm Compost* (80 *Samples*).

	Mean.	Std. Dev.	M. — $\frac{S.D.}{2}$
	%	%	%
Moisture	55·9	19·7	70
Loss on Ignition	43 9	14·2	62*
Total Nitrogen (N)	1 05	0·53	67*
Phosphoric Oxide (P_2O_5)	0·67	0·52	68*
Potash (K_2O)	1·32	0·78	55*

* Expressed on the oven-dry basis.

Moisture comprises more than half the weight of the average sample, while the low P_2O_5 content is again characteristic of the South African product. The nitrogen content is low, compared with the animal manures, while the potash content is barely one quarter of that of Karoo manure. The comparatively poor composition of farm compost should, however, not be a source of discouragement to those who have wisely adopted the practice. It contains as much organic matter as the manures and on account of the ease and cheapness with which it can be made on the farm, there is every reason to encourage its use. Because of its high moisture content and poorer composition, larger dressings should be applied than is usual with manure.

Municipal Compost.—The distribution of the samples (37) was as follows: From Ficksburg, 24; Volksrust, 3; Cedara area, 4; Bethlehem, 2; and one each from Zeerust, Pietersburg, Alberton, Potgietersrust and Heidelberg (Tvl.). Owing to the predominance of samples from Ficksburg it is possible that the values are not strictly representative of municipal composts made throughout the Union, especially as many of the Ficksburg composts contained leather wastes from a local tannery. Reservations made in the case of farm compost with regard to variability of the materials used, etc., also apply in this case.

TABLE XI.—*Municipal Compost* (37 *Samples*).

	Mean.	Std. Dev.	M. — $\frac{S.D.}{2}$
	%	%	%
Moisture	40·2	22·9	65
Loss on Ignition	44·1	16·9	74*
Total Nitrogen (N)	1·81	1·01	67*
Phosphoric Oxide (P_2O_5)	0·80	0·54	62*
Potash (K_2O)	1·15	0·35	63*

* Expressed on the oven-dry basis.

Municipal compost contains considerably more nitrogen than farm compost and is also drier; the percentages of P_2O_5, K_2O and loss on ignition are similar for both types of compost, but neither is as good as the animal manures.

Experiments conducted in recent years with a variety of crops throughout the Union, both on dryland and under irrigation, have, almost without exception, shown that Karoo manure is superior to both farm and municipal compost when the dressings are applied on the basis of equal amounts of dry matter. In most cases, however, the difference may roughly be accounted for in terms of the quantity of plantfoods (N and P_2O_5) added to the soil. When applied on the basis of equal amounts

of P_2O_5 or nitrogen, then compost is frequently superior, as the much larger tonnage of compost which is required on this basis brings much more organic matter into the soil. As it should be possible for the farmer to produce compost for less than the landed cost of the manure, there is in general no important economic advantage of one over the other.

When reduced to the dry basis there is no doubt that animal manures of average composition are more valuable than compost. Thusfar no unassailable evidence has been produced to prove the extravagant claims frequently put forward in respect of superior composition and health of crops grown on composted soil.

Karoo-Manure Ash.—It was frequently the custom in the past to set fire to old manure heaps in order to reduce the bulk. The practice is of course extremely wasteful as nearly all the valuable nitrogen and organic matter is lost during ignition; temperatures are frequently high enough to cause slagging of the ash. The straight ash is rarely sold to farmers; it is usually mixed with the unburned manure and sold as "50-50 Mixture". Unless a farmer specifically wishes to apply potash, there is little to recommend the use of this material for the sake of the small amount of P_2O_5 which it contains. Moreover, it is extremely alkaline, due to the presence of alkali carbonates and should therefore be used sparingly, if at all. In spite of its relative worthlessness, except as a source of potash, considerable tonnages are sold annually to the less informed in the form of "50-50 Mixture".

TABLE XII.—*Karoo-Manure Ash* (15 *Samples*).

	Moisture.	Loss on Ignition.	Total N.	P_2O_5.	K_2O.	Cl.	Na.
	%	%	%	%	%	%	%
Minimum..........	0·67	0·26	0·00	1·41	2·37	0·57	0·20
Maximum..........	14·0	20·2	0·18	3·49	20·0	16·3	11·9
Mean..............	7·0	6·9	0·09	2·41	8·94	5·64	4·15

Expressed on the oven-dry basis.

Goat Manure.—The figures for 10 samples of goat manure, mainly from Willowmore and Ladysmith in the Karoo, are given in Table XIII.

TABLE XIII.—*Goat Manure* (10 *Samples*).

	Moisture.	Loss on Ignition.	Total N.	P_2O_5.	K_2O.
	%	%	%	%	%
Minimum..................	10·0	36·9	1·08	0·37	2·16
Maximum..................	29·9	82·3	2·86	1·62	7·08
Mean......................	18·8	61·1	1·88	0·84	4·07

Expressed on the oven-dry basis.

This product is very similar in composition to Karoo manure. In fact, it is very likely that a large percentage of the older Karoo manure deposits consists partly or even mainly of goat manure.

For the convenient comparison of the various products already described, the following summary of mean values is presented in a single table.

TABLE XIV.—*Summary of mean Composition of Manures, Composts, etc.*

	No. of Samples.	Moisture.	Loss on Ignition.	N.	P_2O_5.	K_2O.	Cl.	Na.
	%	%	%	%	%	%	%	%
Karoo manure (crude)	223	38	52	1·68	1·09	4·92	3·08	2·57
Karoo manure (milled)	81	23	—	—	—	—	—	—
Kraal manure........	29	30	47	1·82	0·63	3·43	—	—
Farm compost.......	80	56	44	1·05	0·67	1·32	—	—
Municipal compost...	37	40	44	1·81	0·80	1·15	—	—
Karoo manure ash....	15	7	7	0·09	2·41	8·94	5·64	4·15
Goat manure........	10	19	61	1·88	0·84	4·07	—	—

Expressed on the oven-dry basis.

Summary.

(1) The rapid war-time expansion in the manure trade is discussed and a detailed survey of the main production and consuming centres is given, based as tonnages transported by the S.A.R.

(2) The average composition of Karoo manure in respect of moisture, loss on ignition, nitrogen, phosphoric oxide, potash and brak salts is shown for the Karoo as a whole and also for grouped samples from the four sub-divisions of the Karoo.

(3) Under South African conditions Karoo manure is used to best advantage in fruit and vegetable producing areas where the valuable nitrogen constituent can be efficiently utilized by crops.

(4) On account of its relatively low P_2O_5 content, Karoo manure is not an ideal dressing for maize. If used for this purpose it should be supplemented with mineral phosphatic fertilizers.

(5) Although the manure is rich in potash, this constituent is of doubtful value when applied under average South African conditions.

(6) A comparison is drawn between the value of milled and crude manure which shows that the farmer receives 75 per cent. better value for his money when buying the latter.

(7) An attempt is made to arrive at the true agricultural value of a ton of manure of average composition. It is shown that at 14s. per ton for crude manure the farmer buys fertility comparatively cheaply.

(8) The nitrogen and potash sold annually in the form of manure form a very significant proportion of the total amount of these plantfoods applied to the soil. In the case of P_2O_5, however, the fertilizer trade in super and other mineral phosphates completely dominates the picture.

(9) The composition and relative merits of farm compost, municipal compost, kraal manure and Karoo manure ash are discussed.

Acknowledgements.

The comprehensive examination of the manure, etc., dealt within this survey was conducted at the instigation of Dr. J. P. van Zyl, Chief of the Division of Chemical Services and Controller of Fertilizers. Mr. U. W. Schmidt was instrumental in organising the collection of the majority of samples and was in charge of the analytical work; many valuable ideas and suggestions from his reports have been used in this article.

The authors also wish to acknowledge their debt to Messrs. E. Fischer and T. P. Pretorius, of the Division of Chemical Services, for the statistical treatment and method of presenting the condensed data. Details of the tonnages transported by rail were supplied by the headquarters of the Railway Administration.

Plant Diseases and Cultural Operations.

[*Continued from page* 307.

sources of nitrogen may be used: Fertilizer Mixture H, nitrate of soda, nitrate of ammonia, guano, etc. By merely applying kraal manure, the nitrogen of which only becomes available slowly to the tree, heavy losses may be suffered before the damaged trees have regained sufficient vegetative vigour to offset the attacks of the disease.

Marked reduction in the foliage of avocado trees due to frost or hail, results in severe sunburn, especially on the trunks and main branches. This sunburnt tissue is invariably attacked especially by the Anthracnose fungus *Colletotrichum gloeosporioides* Penz., and also the fungus *Melanops perseae* (Doidge) Pet., both causing the death of large areas of bark and cambium on the trunks and main limbs. To prevent sunburn and hence the incidence of the fungi, the trunks and main branches should be thoroughly whitewashed soon after the frost or hail damage, and the coating of whitewash renewed as often as it is necessary until the trees have produced sufficient foliage to shade the susceptible areas.

If tomato plants are not too severely damaged by frost or hail they may soon be brought back to a state of profitable production by top-dressing with a nitrogenous fertilizer and by thoroughly dusting the plants with a fungicide, otherwise such plants may become heavily attacked on the stems and branches by the causal fungi of the leaf-spot diseases, "Septoria Leaf Spot" and "Early Blight", causing either a very weak recovery or death of a certain percentage of the vines.

(This subject will be further dealt with in a subsequent article.)

Useful Bulletins.

The following are a few of the bulletins obtainable from the Editor of Publications, Department of Agriculture, Pretoria, post free and prepaid at the prices indicated:—

Poultry Farming.—Bulletin No. 241, by Dr. J. J. Bronkhorst. Price 1s.

Poultry Houses.—Bulletin No. 257, by C. L. Marais and N. J. van Straaten. Price 1s.

Turkeys.—Bulletin No. 264, by E. F. Lombard and Prof. A. M. Geriche. Price 3d.

Classing of Poultry or the Culling of Non-Producers.—Bulletin No. 207, by P. J. Serfontein. Price 3d.

The Small Hive Beetle.—Bulletin No. 220, by Dr. H. E. Lundie. Price 3d.

The Production and Handling of Cream.—Bulletin No. 219, by P. Toens and P. du Preez. Price 3d.

The Preparation of Skins for the Market.—Bulletin No. 263, by P. D. Rose. Price 3d.

Gerbille Control.—Bulletin No. 233, by D. H. S. Davis and A. D. Thomas. Price 3d.

Miscellaneous D.D.T. Studies With special reference to Some Common Agricultural Pests.—Bulletin No. 276. Price 3d.

Laboratory Experiments with New Organic Insecticides.

B. K. Petty, Insecticide Entomologist, Division of Entomology, Pretoria.

PRIOR to the war, arsenic and fluorine compounds, derris, pyrethrum and nicotine were largely relied on for the control of most injurious insects. During the war, however, the diversion of large quantities of inorganic insecticide components to war production and the reduced availability of pyrethrum, derris and nicotine intensified the search for new insecticides, mainly among organic compounds.

As a result of these researches, the past few years have seen the release of several new insecticides into the field of chemical control of insects, and it is the object of this article to present some laboratory results on the effectiveness of five of these materials against some common South African agricultural pests.

Materials.

The insecticides tested were:—

(1) Benzene hexachloride.
(2) D.D.T. (dichloro-diphenyl-trichloroethane).
(3) Chlordane, a chlorinated hydrocarbon insecticide with an empirical formula $C_{10}H_6Cl_8$.
(4) Thiophos 3422 (diethyl p-nitrophenyl thiophosphate). This chemical is an ester of thiophosphoric acid with the formula $C_{10}H_{14}NO_5PS$.
(5) Hexaethyl tetraphosphate, a phosphorous compound having the formula $C_{12}H_{30}O_{13}P_4$.

Experiments have shown that these materials are efficacious in controlling a large number of destructive pests, but it must be borne in mind that their life as insecticides has been comparatively short and there has been insufficient time to investigate their properties thoroughly. Further work is necessary in order to obtain a better understanding of their possible hazards and potential usefulness. Anyone who uses these organic insecticides, therefore, is in a sense an experimenter and for the general good, should report any unusual observations.

As far as our knowledge goes, the chlorinated hydrocarbon insecticides, benzene hexachloride, D.D.T. Chlordane and the phosphorous compound Thiophos 3422, seem to have an adverse effect on only a few plants, the most important of these being the cucurbit family of which many seem to be adversely affected. Tomatoes have shown some evidence of stunting following the use of these insecticides, and maize plants have been injured by the use of benzene hexachloride. Hexaethyl tetraphosphate, on the other hand, has shown no evidence of plant injury when used at the recommended insecticidal strength.

As with all other insecticides, excess applications should be avoided and concentrations should be kept at a minimum until a better understanding of the permanent effects of these materials on plants is obtained.

Owing to the persistent nature of benzene hexachloride, D.D.T., Chlordane and Thiophos 3422 residues, the normal cleaning and washing processes to which fruit and vegetables are normally subjected do not entirely remove the insecticidal deposits. In general, therefore, in the case of edible crops the insecticides should be applied in the early part of the season and not just prior to harvesting. For example cabbages and cauliflowers should not be treated after the heads have formed. If the

edible portions are sprayed or dusted, however, then a period of approximately four weeks should elapse between the time of application of the insecticide and the harvesting of the crop. The treatment of such crops as potatoes, sweet potatoes, onions, etc. involves little risk, as the edible portions of the plant are produced beneath the ground. From the residual aspect there is no reason why these insecticides should not be used on shade trees and ornamental plants. Precautions of this nature do not apply to hexaethyl tetraphosphate which hydrolizes within a few hours when diluted with water, and this prevents any harmful residues remaining on plants.

Apart from the residual problem, there is, in the case of benzene hexachloride, a tendency for certain fruit and vegetables to acquire an unpleasant odour from its use.

Operators should avoid unnecessary skin contact with these insecticides as much as possible, especially when they are in a concentrated form. After spraying or dusting, contaminated skin areas should be washed thoroughly with soap and water and excessive inhalation of dusts and sprays should be avoided.

Testing Methods.

1. In the experiments described in this article, dusting was done with an apparatus described by the author in a previous publication whereby accurate and uniform dosages of the insecticide can be applied.

2. Both prior and subsequent to the application of the insecticides the test insects were kept under constant temperature and humidity conditions (75° F. and 70 per cent. R.H.).

3. In all experiments both the insects and their food plants were dusted and the insects were confined in cages with the treated food for 24 hours. Thereafter they were transferred to clean cages with untreated food. The percentage "knock-down" was recorded every hour for a period of six hours and mortality records were made at 24 hourly intervals until all the insects were dead or had apparently recovered.

4. The mortality figures presented in the tables have been corrected for normal mortality by means of Abbot's formula. In no case did the natural mortality exceed 10 per cent. and in the majority of tests it was below this figure.

I. The Elegant Grasshopper (*Zonocerus elegans*, Thumb).

The Elegant Grasshopper, also known as the "Stinksprinkaan", often does a great deal of damage in lands, gardens and orchards by its attack on a variety of plants. The favourite plant of young hoppers is the common milkweed (*Asclepias fruticosa*), although both nymphs and adults will eat almost any plant product.

The adults are brightly coloured green, yellow and pink insects. They are never strong fliers and in the majority the wings are rudimentary or undeveloped. They do not form definite swarms, but tend to congregate in small groups at nightfall. The female lays her eggs in the ground during autumn and these hatch the following spring. The newly emerged hoppers are black with yellow stripes and markings on their bodies and they cluster closely together on plants for a few days after hatching.

From the control point of view the best times to apply poisons are when they congregate at nightfall or when they are clustered in their young stages.

The insecticides tested were 5 and 10 per cent. benzene hexachloride, 10 per cent D.D.T., 5 per cent. Chlordane and 2 per cent. Thiophos 3422. They were used as dusts and were applied at the rate of 0·16 mg. and 0·22 mg. per sq. cm. which is the equivalent of 15 and 20 lb. per acre in field application; 30 insects were used for each insecticide in each experiment.

Results.

The results obtained with the dusts are given in table 1.

TABLE 1.—*Tests on the Elegant Grasshopper.*

No. of Expt.	Insecticides.	Age of Insects.	Dosage (per acre).	Final mortality.	Time required for % final mortality.
			lb.	%	hours.
1	5% Benzene hexachloride...	Half grown Hoppers	15	26·6	48
	10% Benzene hexachloride...			100·0	24
	10% D.D.T..................			16·6	48
	5% Chlordane.............			100·0	48
	2% Thiophos 3422.........			100·0	24
2	5% Benzene hexachloride...	Half grown Hoppers	15	33·3	48
	10% Benzene hexachloride...			100·0	48
	10% D.D.T..................			13·3	48
	5% Chlordane.............			100 0	48
	2% Thiophos 3422.........			100·0	24
3	5% Benzene hexachloride...	Three-quarter grown Hoppers	15	26·6	48
	10% Benzene hexachloride...			80·0	48
	10% D.D.T..................			10·0	48
	5% Chlordane.............			96·6	48
	2% Thiophos 3422.........			100·0	48
4	5% Benzene hexachloride...	Three-quarter grown Hoppers	20	—	—
	10% Benzene hexachloride...			100·0	24
	10% D.D.T..................			13·3	48
	5% Chlordane.............			100·0	48
	2% Thiophos 3422.........			100·0	24
5	5% Benzene hexachloride...	Adults	20	40·0	48
	10% Benzene hexachloride...			96·6	48
	10% D.D.T..................			—	—
	5% Chlordane.............			96·6	48
	2% Thiophos 3422.........			100·0	24
6	5% Benzene hexachloride...	Adults	20	33·3	48
	10% Benzene hexachloride...			100·0	48
	10% D.D.T..................			—	—
	5% Chlordane.............			96·6	48
	2% Thiophos 3422.........			100·0	24

Conclusions.

(1) Taking into consideration rapidity of action and final mortality, Thiophos 3422 at 2 per cent. concentration is superior to 5 and 10 per cent. benzene hexachloride, 10 per cent. D.D.T. and 5 per cent. Chlordane.

(2) In general, 10 per cent. benzene hexachloride causes a quicker rate of mortality than 5 per cent. Chlordane, although the final mortality obtained with the two insecticides is similar. A 5 per cent. benzene hexachloride concentration appears to be too weak for effective control.

(3) 10 per cent. D.D.T. is relatively ineffective.

(4) There is some indication that young hoppers are more susceptible to the poisons than the older ones or the adult insects.

(5) The results suggest that 2 per cent. Thiophos 3422, 10 per cent. benzene hexachloride and 5 per cent. Chlordane should be effective for the control of *Zonocerus elegans* if used at the rate of 20 lb. per acre.

II. Ground Weevils (*Protostrophus* sp.)

The Division of Entomology is receiving many requests from farmers and gardeners for information on the control of ground weevils. These insects appear most frequently as pests on new lands which have recently been put under cultivation. Under natural conditions the full grown weevils live on grass and other veld plants, while those in the immature stage feed on the roots of these plants. When their natural food plants are destroyed, as with ploughing, they appear on the newly planted crop in great numbers.

Records show that among the plants attacked are mealies, cotton, potatoes, tobacco and groundnuts, and they have also been known to damage young fruit trees.

The insecticides tested were 5 per cent. benzene hexachloride, 5 per cent. D.D.T., 5 per cent. Chlordane, 2 per cent. Thiophos 3422 and natural cryolite. The poisons were used as dusts and were applied at the rate of 0·11 mg., 0·16 mg. and 0·22 mg. per sq.cm., which is equivalent to field applications of 10, 15 and 20 lb. per acre; 30 adult beetles were used for each insecticide in each experiment.

Results.

The results of the experiments are summarised in table 2.

TABLE 2.—*Tests on Ground Weevils.*

Insecticides	Dosage (per acre).	Final mortality.	Time required for % final mortality.
	lb.	%	hours.
5% Benzene hexachloride	20	100·0	24
	15	100·0	24
	10	100·0	48
5% D.D.T.	20	100·0	48
	15	100·0	48
	10	96·6	72
5% Chlordane	20	100·0	24
	15	100·0	48
	10	100·0	72
2% Thiophos 3422	20	100·0	24
	15	—	—
	10	100·0	24
Natural Cryolite	20	66·6	120
	15	53·3	96
	10	—	—

Conclusions.

(1) Thiophos 3422, benzene hexachloride, Chlordane and D.D.T. are highly toxic to the adult beetles. Natural cryolite is considerably less effective than the other insecticides tested.

(2) 2 per cent. Thiophos 3422 is more rapid in action than either benzene hexachloride, Chlordane or D.D.T. when used at 5 per cent. concentration.

(3) Benzene hexachloride is superior to both Chlordane and D.D.T. as regards rapidity of action. Chlordane appears to be slightly more effective than D.D.T. in this respect.

(4) The results suggest that Thiophos 3422 used at a concentration of 2 per cent. and benzene hexachloride, Chlordane and D.D.T. at 5 per cent. concentration should be effective in controlling Protostrophus beetles if applied at the rate of 10 to 15 lb. per

acre Cryolite is considerably less effective than these four insecticides and, if used, should be applied at the rate of 20 lb. per acre or more.

III. The Astylus Beetle (*Astylus atromaculatus*, Bl.)

The Astylus beetle is a small black and yellow spotted insect about $\frac{3}{8}$ to $\frac{1}{2}$ inch in length and is sometimes confused with C.M.R. beetles which, however, belong to quite a different family. The insect appears to have been introduced from South America during the Anglo-Boer War and has become established as a pest in this country. It is attracted to flowers and often forms clusters on maize and bean plants and on many garden flowers, feeding on parts of the flower and on pollen. It has also become a troublesome pest on young maize cobs. As a leaf feeder it is not a troublesome pest.

Spraying or dusting with stomach poisons was found to be ineffective for the control of these insects, as it was difficult to make the poison adhere to the flowers in sufficient quantities to prove lethal. Tests were therefore undertaken to determine the relative efficacy of some of the newer contact poisons when used against this pest.

The insecticides used were 2 per cent. Thiophos 3422, 5 per cent. benzene hexachloride, 5 per cent D.D.T. and 5 per cent Chlordane. The materials were applied as dusts at the rate of 0·11 mg., 0·16 mg. and 0·22 mg. per sq. cm. or 10, 15 and 20 lb. per acre; 50 Astylus beetles were used for each insecticide in each experiment.

Results.

Table 3 summarises the mortalities obtained with the different poisons.

TABLE 3.—*Tests on the Astylus Beetle.*

No. of Expt.	Insecticides.	Dosage (per acre).	Final mortality.	Time required for % final mortality.
		lb.	%	hours.
1	5% Benzene hexachloride	10	10·0	72
	5% D.D.T.		60·0	72
	5% Chlordane		100·0	72
	2% Thiophos 3422		100·0	72
2	5% Benzene hexachloride	15	40·0	72
	5% D.D.T.		98·6	48
	5% Chlordane		100·0	48
	2% Thiophos 3422		100·0	24
3	5% Benzene hexachloride	15	56·6	72
	5% D.D.T.		97·3	48
	5% Chlordane		100·0	48
	2% Thiophos 3422		100·0	24
4	5% Benzene hexachloride	20	100·0	72
	5% D.D.T.		100·0	48
	5% Chlordane		100·0	24
	2% Thiophos 3422		100·0	24

Conclusions.

(1) Thiophos 3422, Chlordane, D.D.T. and benzene hexachloride are all toxic to Astylus beetles.

(2) 2 per cent. Thiophos 3422 is superior to Chlordane, D.D.T. and benzene hexachloride when used at 5 per cent. concentration.

(3) The results suggest that 2 per cent. Thiophos 3422 and 5 per cent. Chlordane should prove effective against these insects when applied at the rate of 10 lb. per acre. The 5 per cent. D.D.T. should be used at least 15 lb. per acre, while 5 per cent. benzene hexachloride should be applied at 20 lb. per acre to give satisfactory control.

IV. C. M. R. Beetles (*Decapotoma lunata*, Pall.)

These yellow and black banded beetles are sometimes known as blister beetles owing to an oily secretion in their bodies which blisters the flesh. There are many different species in South Africa, ranging in size from ½ inch to 1¼ inches in length. The toxity tests described here were, however, done with ony one species, *Decapotoma lunata*, which represents one of the commonest species occurring in this country.

The life-history of these beetles is complicated. The immature stages of certain species are passed as parasites inside the egg-cases of locusts and other allied insects.

The adult beetles are commonly seen in gardens and orchards where they sometimes appear in large numbers feeding on the leaves and flowers of peas and beans, the leaves of potatoes and the blossoms of many plants, including fruit trees.

The insecticides tested for the control of these insects were 5 and 10 per cent. benzene hexachloride, 5 and 10 per cent. D.D.T., 5 per cent. Chlordane and 2 per cent. Thiophos 3422 all applied at the rate of 0·22 mg. per sq. cm. or 20 lb. per acre; 30 insects were used for each insecticide in each experiment.

Results.

The results of these tests are summarised in table 4.

TABLE 4.—*Tests on the C.M.R. Beetle.*

No. of Expt.	Insecticides.	Dosage (per acre).	Final mortality.	Time required for % final mortality.
		lb.	%	hours.
1	5% Benzene hexachloride		66·6	72
	10% Benzene hexachloride		100·0	24
	5% D.D.T.		100·0	48
	10% D.D.T.	20	100·0	24
	5% Chlordane		100·0	24
	2% Thiophos 3422		100·0	24
2	5% Benzene hexachloride		76·6	48
	10% Benzene hexachloride		100·0	24
	5% D.D.T.		100·0	48
	10% D.D.T.	20	100·0	24
	5% Chlordane		100·0	24
	2% Thiophos 3422		100·0	24
3	5% Benzene hexachloride		63·3	48
	10% Benzene hexachloride		100·0	24
	5% D.D.T.	20	100·0	48
	10% D.D.T.		100·0	24
	5% Chlordane		100·0	24
	2% Thiophos 3422		100·0	24

Conclusions.

(1) 2 per cent. Thiophos 3422, 10 per cent. benzene hexachloride, 10 per cent. D.D.T. and 5 per cent. Chlordane all caused complete mortality in 24 hours, but the rate of "knock-down" was

considerably faster with Thiophos 3422 than with the other insecticides.

(2) 5 per cent. Chlordane produced a faster "knock-down" than did 5 per cent. D.D.T., but was no quicker than 10 per cent. D.D.T. Benzene hexachloride was the least effective of the four insectisides.

(3) The results suggest that control of C.M.R. beetles of the species *Decapotoma lunata* should be obtained by the application of 2 per cent. Thiophos 3422, 5 per cent. Chlordane, 5 per cent. D.D.T. and 10 per cent. benzene hexachloride at the rate of 20 lb. per acre. It is probable that good control would be obtained with these insecticides at lower dosages. A 5 per cent. benzene hexachloride concentration appears to be too weak for effective control, whereas 10 per cent. D.D.T. appears to be an unnecessary high concentration for the control of these insects.

V. Fruit-Eating Beetles (*Pachnoda impressa,* Gold.)

The fruit-eating beetles belong to the family *Scarabaeidae* which is well represented in South Africa. The most destructive species are *Pachnoda rufa, Pachnoda sinuata, Pachnoda cincta* and *Pachnoda impressa.* Beetles belonging to the latter species were used as test insects in the following experiments.

These Cetonid beetles cause serious damage to ripe and ripening fruit and when present in large numbers they are capable of destroying a high proportion of the fruit crop.

The insecticides tested were 5 per cent. and 10 per cent. benzene hexachloride, 5 per cent and 10 per cent. D.D.T., 5 per cent. Chlordane, 2 per cent. Thiophos 3422 and natural cryolite. These dusts were applied at the rate of 0·22 mg. per sq. cm. or 20 lb. per acre; 30 beetles were used for each insecticide in each experiment.

Results.

The mortality figures obtained with these dusts are presented in table 5.

TABLE 5.—*Tests on Fruit-eating Beetles.*

No. of Expt.	Insecticides.	Dosage (per acre).	Final mortality.	Time Required for % final mortality.
		lb.	%	hours.
1	5% Benzene hexachloride	20	40·0	120
	5% D.D.T.		20·0	120
	5% Chlordane		6·6	120
	2% Thiophos 3422		100·0	24
2	5% Benzene hexachloride	20	36·6	96
	5% D.D.T.		23·3	96
	5% Chlordane		13·3	96
	Natural Cryolite		6·6	120
3	10% Benzene hexachloride	20	56·6	120
	10% D.D.T.		26·6	120
	2% Thiophos 3422		100·0	24
	Natural Cryolite		10·0	120
4	10% Benzene hexachloride	20	60·0	120
	10% D.D.T.		26·6	120
	5% Chlordane		16·6	120
	2% Thiophos 3422		100·0	24

Conclusions.

(1) Neither D.D.T., Chlordane nor natural cryolite can be considered for the control of fruit-eating beetles at the concentrations and application used in these tests.

(2) 2 per cent. Thiophos 3422 is highly toxic to these insects and is far superior to 10 per cent. benzene hexachloride, which is the only other insecticide among those tested which could be considered for use against this pest.

(3) The results suggest that Thiophos 3422 applied at the rate of 20 lb. or less per acre should provide effective control. 10 per cent. benzene hexachloride, applied at the rate of 20 lb. or more per acre, should afford some measure of control, but there is the danger of taste contamination to ripe and ripening fruit with this insecticide.

VI. Red Spider (*Tetranychus bimaculatus*, Harvey.)

This mite is extremely abundant at certain times in most parts of South Africa. It is common on Cape gooseberry, plum, peach, beans, violets, cotton, tomato, sweetpeas, beans, holly-hock and many other plants are often found to be heavily infested.

The adult female varies greatly in colour, being sometimes greenish or yellowish but most often brick red. The adult male is paler in colour.

The female lays 50 to 100 eggs after which she dies. The eggs hatch in from four to five days in summer and the young six-legged nymphs appear.

The mites have sucking mouthparts and puncture the surface of the leaves to suck the sap. The presence of mites soon becomes evident by the white bleached appearance of the leaves which later turn brown and drop off.

Extensive experiments are at present being carried out on control measures for these mites, but they have not yet reached finality. A full report on the results of these tests will be published at a later date.

Sufficient data are available, however, to indicate that a spray containing hexaethyl tetraphosphate diluted 1 to 1200 with water, and 1 per cent. an 2 per cent. Thiophos 3422 dusts are highly effective in controlling adults and nymphs. None of these insecticides will, howbver, kill mite eggs.

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"Blue Disease" of Tomatoes.

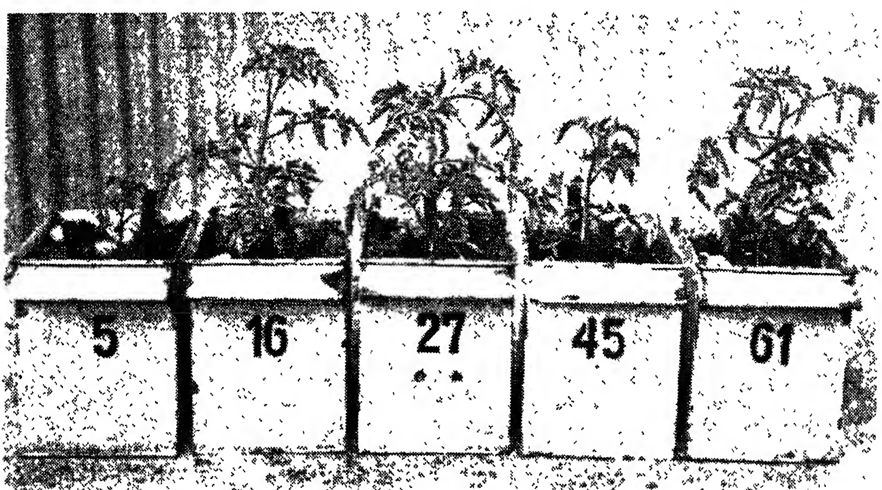
W. B. Goldschmidt, Division of Chemical Services.

DURING the winter of 1945 attention was drawn to a peculiar tomato disease occurring in the Malelane area of the eastern Transvaal Lowveld. Affected plants showed greatly reduced yields. The area concerned is considered to be one of the most important in the Union for the production of winter vegetables, and tomatoes figure largely in the total value of the vegetables produced there.

During the war farmers experienced the greatest difficulty in procuring adequate supplies of kraal manure and inorganic fertilizers. With the insistent demand for more intensive production, many farmers were inclined to plant up larger areas than was justified by their supplies of kraal manure and fertilizers. This resulted in a lower level of available plant nutrients in the soil and in certain soil types deficiency diseases made their appearance.

Symptoms of the Disease.

An examination of the diseased plants showed a reddish purple colouration of the leaves, confined mainly to the underside of the leaf. A study of this occurrence in the field indicated that the disease was not confined to isolated plants, but that practically all plants in an affected block showed the symptoms to a lesser or greater degree. The disease



Control. Super. Kraalmanure, heavy. Kraal manure, light. Super and Kraal manure.

FIG. 1.

appeared to start as localized pigmented spots, which gradually spread over the entire leaf with the veins finally becoming dark reddish purple. The leaves of affected plants were small in comparison with healthy ones, the plants were dwarfed, and the setting of fruit was much delayed. In severe cases plants died before any fruit formed. Information received from farmers in the area stressed the point that this disease was liable to appear as soon as cold weather set in.

Soil Analysis.

Analysis of soil samples from this blue disease area, indicated that the amounts of organic matter, nitrogen, potash, calcium, and magnesium found in this soil were adequate for the support of normal plant growth. The soil was found to be neutral in reaction, suggesting a low phosphate fixing capacity. The total phosphate (·048 per cent. P_2O_5) and the available phosphate (·0005 per cent. P_2O_5) were considered too low for good tomato growth. The soil contained very high amounts of iron and aluminium oxides (28·5 per cent. $Fe_2O_3 + Al_2O_3$) which suggested an unusually high phosphate fixing capacity, despite the neutral reaction of the soil.

The relative phosphate fixing capacity of the Malelane soil was determined and it was discovered that this soil fixed approximately 15 times more phosphate than the granite soils of the Nelspruit area. These granitic soils have always responded well to phosphatic fertilizers. Hence it was anticipated that in the poor availability of the phosphate in the Malelane soil might lie the answer to the problem.

Effect of Frequency of Irrigation and Time of Application of Fertilizer.

A co-operative experiment was started in May 1947 by Mr. W. Basson (formerly Vegetable Production Officer at this Station), on Mr. B. M. de Villiers' farm at Malelane to study the effect of frequency of irrigation at 2, 4, 8 and 16-day intervals on the availability of phosphate, and also to ascertain whether or not superphosphate applied at planting-out time was better than the same quantity of superphosphate applied later in two top-dressings. Superphosphate (15·1 per cent.) was applied at the rate of 1,500 lb. per morgen, and all plots received kraal manure at the rate of 20 tons per morgen.

Tomatoes receiving superphosphate at planting time were from the outset outstandingly better than those in the other section. There was no sign of blue disease and all plants in this series possessed the characteristic full green colour exhibited by healthy and vigorous tomato plants. The plants on the plots which received superphosphate as a top-dressing developed blue disease very markedly. After the first topdressing of super was applied, these symptoms began to disappear and the plants gradually returned to normal. These plants, however, never quite caught up with the others that received super at planting time. The weights of 8 pickings of tomatoes harvested over the period 1 September, 1947, to 14 October, 1947, were recorded by Mr. de Villiers. The highest yield was obtained from plots irrigated at 8-day intervals. The period of the experiment was from 13 May to 14 October 1947—a period when the water requirements of the plants would be lower than at any other time of the year. The soil is a deep heavy alluvium having a total water capacity of 74 per cent., i.e. a soil with a remarkably high water-holding capacity. Despite these facts it is evident that maximum yields of tomatoes will only be obtained by irrigating at approximately weekly intervals. This serves to indicate that the tomato has a high water requirement.

Tomatoes receiving super at planting-out time gave the equivalent of 2,900 boxes per morgen, whereas where super was applied in two topdressings a return of only 1,900 boxes per morgen was recorded. As the total amount of fertilizer and manure applied was in both cases identical, it is obvious that the former treatment gave an increase of 1,000 boxes per morgen and that, in addition, labour had been saved. It is felt that this substantial increase in yield was due to the greater efficiency of superphosphate applied at planting-out time. Fertilizer given at the time of planting was applied in the row at 3 to 4 inch depth,

i.e. immediately adjacent to the plant root area. Super applied as a topdressing is gradually dissolved and in its passage down through the soil to the plant root area a greater percentage is fixed in the soil, and is lost to a short-term crop like tomatoes.

Pot Experiment.

In conjunction with the above experiment conducted in the field, a pot experiment using the Malelane soil was conducted under controlled conditions. All findings in the field were amply confirmed by pot experimentation as can be seen in Fig. 1.

Control. Super. K. M. heavy. K. M. light. Super and K. M.

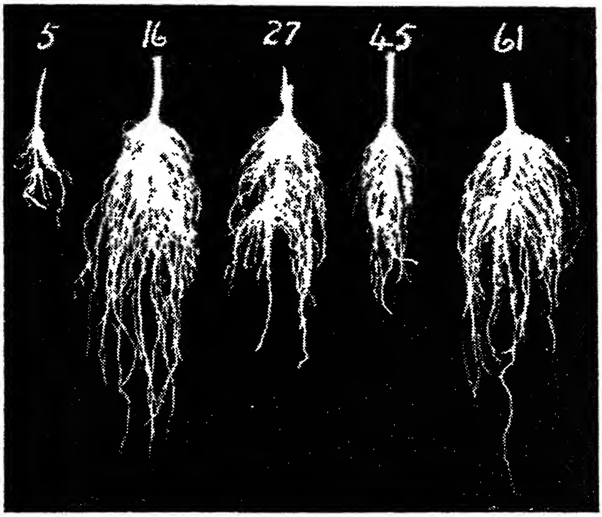


FIG. 2.

Blue disease developed very severely in the control, which made little or no growth. Super, heavy kraal manure and super + kraal manure, all gave pronounced growth responses over the control, and all were normal healthy plants with full green colour. All the pots of the light kraal manure series were normal in colour, but growth was retarded as compared with the other treatments excepting the control. Under field conditions it will be remembered that tomatoes receiving only 20 tons kraal manure per morgen at planting-out time, developed blue disease, whereas one quarter of this application in the pots was sufficient to prevent the occurrence of this deficiency disease. From this one must conclude that the phosphate in kraal manure in the pots became more available in a shorter time than under field conditions. In pots the kraal manure is thoroughly mixed with the entire mass of soil prior to packing of the pot. This, in addition to uniform moisture conditions in the pots, leads to quicker decomposition of the manure and, in consequence, increases the rate of availability of phosphate.

The root systems of the plants shown in Fig. 1 were carefully removed from the pots and dried, and are shown in Fig. 2.

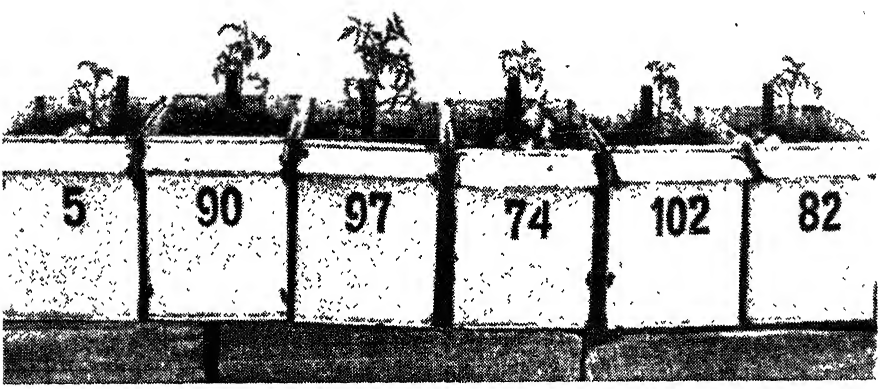
In the control there is virtually no root development. Where super was applied, extensive root development took place, with a marked tendency towards a deeper root system. The heavy kraal manure dressing resulted in excellent root growth, but the majority of these roots lie near the soil surface. Plants having this type of root system would require more frequent light irrigations.

The response of tomatoes to fertilizers other than phosphate on the Malelane soil is indicated photographically in Fig. 3.

With the exception of the sulphate of ammonia treatment, all plants under the remaining treatments developed very severe blue disease. The small response to sulphate of ammonia is interpreted as a phosphate response, and may be due to slight acidification of the soil caused by this fertilizer. This acidification probably increased the availability of the insoluble phosphate held originally in the soil.

In the absence of sufficient available phosphate in this soil type, tomatoes gave no response to nitrogen, calcium, magnesium or potash.

The possibility that the marked response to superphosphate may have been due to trace elements contained in all natural superphosphates has not been overlooked. Certain tomato plants severely affected with blue disease were treated with several of the purest forms of phosphate obtainable, and in every case the deficiency disease was cured within a week.



Control. Nitrate of soda. Sulphate of ammonia. Lime. Magnesite. Potash.

FIG. 3. [*Photos: J. A. van Zyl*].

The writer would also like to mention here his personal experience of a similar deficiency in other crops. Phosphate deficiency has been noted to occur in the artificial pastures of the Natal mist-belt. On soils deficient in phosphate *Paspalum dilatatum* exhibits this deficiency by the formation of reddish purple pigment along the edges of the grass leaf; the tips of the grass leaves are usually heavily pigmented.

Phosphate deficiency in maize can be detected in most varieties and strains by the presence of the same pigmentation occurring on both leaves and stems. This colouration, according to De Turk, is due to the effect of accumulated sugars on the formation of the purple pigment anthocyanin. The accumulation of sugars in plants is the direct result of phosphate deficiency, but the colour is dependent on the presence of a genetic factor for purple pigment production in the particular strain of maize affected. In other words, certain strains of maize may not show pigmentation although suffering from phosphate deficiency. The possibility of the existence of certain strains of tomatoes which do not show this pigmentation under stress of phosphate deficiency must not be overlooked.

The tomato is a heat-loving plant and any unfavourable conditions of growth such as would be occasioned by a prolonged spell of cold weather, will invariably cause the "blueing" of young plants—even

 [*Continued on page* 344.

Central Egg-Laying Competition at Glen.

Twenty-second Open Competition and Fourteenth Test of the Registered Breeders' Association.

J. A. de Beer, College of Agriculture, Glen, O.F.S.

THE above open competition and the Breeders' Register Test commenced on 1 April 1947 and terminated on 1 March 1948. A total of 360 hens was entered for the former—a decrease of 150 hens as compared with the previous competition; and 530 for the Breeders' Register Test- and increase of 170 hens as compared with the previous test.

For the Open Competition a pen consists of five hens, of which the four best hens are taken into account. For the Breeders' Association Test a pen consists of ten hens, of which the best eight birds are taken into account. In this case the hens must be the progeny of registered parents, and the owner must be a member of the South African Poultry Breeders' Association.

Although the two contests differ and are therefore given separately, they are indentical in the following respects:— (1) The methods of treatment, feeding and housing; (2) the manner in which the eggs are collected, weighed and recorded; and (3) the commencing date of the the contests which extend over a period of 48 weeks, divided into 12 periods of 28 days each.

At the close of each period the egg-production record, together with full details of the positions, moulting, broodiness, sick hens treated, highest producers and general climatic conditions were sent to each competitor.

Ration.

The ration was the same as in previous years, viz.:

(*a*) *Mash*—Yellow mealie, 33·5 lb.; lucerne meal, 10 lb.; beanmeal, 2·5 lb.; wheaten bran, 30 lb.; meat-meal, 3 lb.; carcase meal, 6 lb.; bonemeal, 2·5 lb.; groundnut oilcake, 5 lb.; white fishmeal, 5 lb.; powdered oyster shell, 3 lb. and fine salt, 1 lb.

(*b*) *Cereals*: Crushed yellow mealies.

The egg recording and inspections were carried out in the same way as in the previous years. Only grade "A" eggs were taken into account for positions and certificates.

A comparison of the figures for the Open Competition [see Table 1 (*a*)] with those of the previous year, will reveal a decrease in the average total production of 0·5 per cent.

The average total production of "A" eggs decreased by 4·8 per cent. in comparision with that of the previous year, while the average total production of grade "B" eggs decreased by 0·5 per cent. and that of grade "C" eggs increased by 4·8 per cent.

A comparison of the figures for the Breeders' Register Test [see Table 1 (*b*)] with those of the previous year will reveal an increase in the average total production of 2·9 per cent. The average total production

of " A " eggs decreased by 3·6 per cent. in comparision with that of the previous year, while the average total production of grade " B " eggs increased by 1·8 per cent., and that of grade " C " eggs by 4·7 per cent.

Thus, it would seem that the percentage of grade " A " eggs gradually decreased, while that of grade " B " and " C " eggs increased.

TABLE I.—*Average Production per Hen.*

(1) (*a*) *Open Competition.*

Breed.	No. of Hens.	Production.			Total.
		A.	B.	C.	
White Leghorn	144	180·4	18·4	7·1	206·0
Black Australorp	102	176·4	16·3	5·3	198·1
Rhode Island Red	47	159·3	22·3	7·1	188·9
White Australorp	5	187 0	11·8	5·4	204·2
Light Sussex	7	161·4	9·8	6·0	177·3
White Wyandotte	5	174·8	18·6	10·8	204·3
TOTAL	310	175·5	18·0	6·5	200·1

(*b*) *Breeders' Register.*

White Leghorn	286	186·7	14·2	6·3	207·3
Black Australorp	113	172·1	16·1	5·5	193·7
Rhode Island Red	55	165·9	31·9	7·5	205·2
White Australorp	7	182·0	21·9	3·7	207·6
Light Sussex	9	143·3	30·0	4·1	177·4
TOTAL	470	179·8	17·1	6·2	203·2

Winners.

During the second inspection 126 hens some of which were high producers, were disqualified. The result was that the total production, here recorded, is much lower than what it was originally.

(1) In the *Open Competition* the production figures in respect of the best hens, i.e. those awarded the Blue Ribbon, were as follows:—

Best hen in each Division with a maximum of 250 " A " eggs.

Breed.	Hen No.	Pen No.	Production.			Total.	Owner.
			A.	B.	C.		
Black Australorp	190	38	259	0	1	260	J. L. v. d. Walt.
White Leghorn	208	42	254	6	0	260	W. F. Brunner.

(2) *Breeders' Register.*

Black Australorp	562	114	271	1	0	272	J. F. J. van Rensburg.
White Leghorn	662	134	298	1	2	301	Glenaholm Poultry Farm.

TABEL II.—*Best Pens (Special Certificate).*

(a) Open Competition (best 4 hens).

Position.	Breed.	Pen.	Breed.	Production.			Total.	Owner.
				A.	B.	C.		
1st...	Heavy	20	B. Austrl.	928	10	1	939	Croaghanmora Poultry Farm.
1st...	Light	42	W.L.	904	50	3	957	W. G. Brunner.
2nd...	Heavy	1	W.L.	869	30	2	901	Mrs. A. W. Bartlet.
2nd...	Light	50	W.L.	869	24	9	902	Hasell & Krohn.
3rd...	Heavy	5	R.I.R.	846	29	14	889	Glenaholm Poultry Farm.
3rd...	Light	61	W.L.	849	16	6	871	Grootfontein College of Agriculture.
3rd...	Light	70	W.L.	849	21	12	882	W. J. van Tonder.

(b) Breeders' Register. (Best 8 hens)

Position.	Breed.	Pen.	Breed.	A.	B.	C.	Total.	Owner.
1st...	Heavy	114	B. Austrl.	1,653	78	16	1,747	J. F. J. v. Rensburg.
1st...	Light	144	W.L.	1,817	9	6	1,832	Dan Jacobs.
2nd...	Heavy	104	B. Austrl.	1,597	95	24	1,713	Glen Agriculture College.
2nd...	Light	142	W.L.	1,793	7	4	1,804	Hollandia Poultry Farm.
3rd...	Light	146	W.L.	1,757	92	79	1,928	Mrs. W. F. C. Johnson
3rd...	Heavy	76	R.I.R.	1,542	66	13	1,621	Glenaholm Poultry Farm.

The following Tables show the highest individual production and the highest production per pen of the best 4 hens in 336 days from the first Central Egg-laying Competition.

TABLE III.

(a) Highest Individual Production.

Year.	Open Competition.				Breeders' Register.			
	Production.			Breed.	Production.			Breed.
	A.	B.	C.		A.	B.	C.	
1926–27	269	4	0	White Leghorn				
1927–28	284	0	0	White Leghorn				
1928–29	298	1	0	White Leghorn				
1929–30	314	0	0	B. Australorp				
1930–31	258	4	0	B. Australorp				
1931–32	285	1	0	White Leghorn				
1932–33	275	1	0	White Leghorn	The first Breeders' Reg. Test began			
1933–34	280	4	0	White Leghorn	in 1934.			
1934–35	284	1	0	White Leghorn	274	4	0	White Leghorn.
1935–36	270	9	0	White Leghorn	267	1	0	B. Australorp.
1936–37	270	15	0	White Leghorn	275	2	0	White Leghorn.
1937–38	267	0	0	White Leghorn	267	0	0	White Leghorn.
1938–39	286	16	0	White Leghorn	267	2	0	B. Australorp.
1939–40	302	0	1	White Leghorn	276	12	0	White Leghorn.
1940–41	300	3	0	White Leghorn	254	13	4	White Leghorn.
1941–42	273	12	3	White Leghorn	285	14	0	White Leghorn.
1942–43	283	3	4	White Leghorn	269	16	1	White Leghorn.
1943–44	273	0	1	B. Australorp	258	0	4	White Leghorn.
1944–45	327	0	1	B. Australorp	302	1	0	B. Australorp.
1945–46	292	3	1	White Leghorn	304	0	1	B. Australorp.
1946–47	301	4	0	B. Australorp	301	1	0	B. Australorp.
1947–48	259	0	1	B. Australorp	298	1	2	White Leghorn.

(*b*) *Pen with highest production* (*best* 4 *hens*).

(i) *Open Competition*.

From the first Central-Egg-laying Competition (1926) until 1932 the production of the whole pen of 5 hens is given.

Since the 1931-33 competition the production of the best 4 hens in the pen only is given and the pens with the highest production as follows:—

Year.	LIGHT BREEDS.				HEAVY BREEDS.			
	PRODUCTION.			Breed.	PRODUCTION.			Breed.
	A.	B.	C.		A.	B.	C.	
1932–33	974	34	0	White Leghorn	950	5	1	B. Australorp.
1933–34	1,012	6	0	White Leghorn	931	31	0	B. Australorp.
1934–35	1,019	6	0	White Leghorn	982	50	0	B. Australorp.
1935–36	971	24	3	White Leghorn	855	65	5	B. Australorp.
1936–37	993	49	2	White Leghorn	997	65	2	B. Australorp.
1937–38	921	27	1	White Leghorn	905	14	0	L. Sussex.
1938–39	992	66	22	White Leghorn	928	9	1	R.I.R.
1939–40	1,063	3	3	White Leghorn	1,025	2	2	R.I.R.
1940–41	988	68	1	White Leghorn	943	21	1	B. Australorp.
1941–42	970	63	4	White Leghorn	945	58	1	B. Australorp.
1942–43	964	7	1	White Leghorn	989	20	4	B. Australorp.
1943–44	909	43	1	White Leghorn	970	47	5	B. Australorp.
1944–45	1,011	7	1	White Leghorn	1,110	33	2	B. Australorp.
1945–46	1,027	15	4	White Leghorn	1,046	15	1	R.I.R.
1946–47	1,064	14	3	White Leghorn	896	4	1	B. Australorp.
1947–48	904	50	3	White Leghorn	928	10	1	B. Australorp.

(ii) *Breeders' Register* (*best* 8 *hens*).

Year.	PRODUCTION.			Breed.
	A.	B.	C.	
1934–35..............................	1,860	15	0	White Leghorn.
1935–36..............................	1,820	138	2	White Leghorn.
1936–37..............................	1,993	75	0	White Leghorn.
1937–38..............................	1,850	183	4	White Leghorn.
1938–39..............................	1,948	40	5	White Leghorn.
1939–40..............................	1,912	105	12	White Leghorn.
1940–41..............................	1,783	126	6	White Leghorn.
1941–42..............................	1,750	90	9	White Leghorn.
1942–43..............................	1,750	119	1	White Leghorn.
1943–44..............................	1,838	32	6	White Leghorn.
1944–45..............................	1,932	10	7	White Leghorn.
1945–46..............................	1,954	13	5	Black Australorp.
1946–47..............................	1,927	12	5	White Leghorn.
1947–48..............................	1,817	9	6	White Leghorn.

TABLE IV.

The following hens laid 275 and more "A" eggs in 336 days, and were consequently tested for 365 days. Their production during the 365 days was as follows:—

Hen No.	Pen	Breed.	PRODUCTION.			Owner.
			A.	B.	C.	
662........	134	White Leghorn.....	322	1	2	Glenaholm Poultry Farm.
900........	180	White Leghorn.....	298	1	2	J. S. Willies.

TABLE V.—*Hens with Highest Production.*

(*a*) *Open Competition.*

Breed.	No. in Competition.	From 240 "A" Eggs.		From 220 "A" Eggs.		From 200 "A" Eggs.	
		No. of Breed.	Percentage of Breed.	No. of Breed.	Percentage of Breed.	No. of Breed.	Percentage of Breed.
W.W....	5	1	20·0	2	40·0	—	—
R.I.R........	47	3	6·4	3	6·4	8	17·0
L.S....	7	—	—	—	—	2	28·6
W.A.......... ...	5	1	20·0	1	20·0	—	—
B.A.......	102	12	11·7	12	11·7	14	13·7
W.L.............	144	9	6·2	25	17·3	24	16·6
TOTAL	310	26	8·4	43	14·0	48	15·5

(*b*) *Breeders' Register.*

Breed.	No. in Competition.	From 240: No. of Breed.	From 240: Percentage of Breed.	From 220: No. of Breed.	From 220: Percentage of Breed.	From 200: No. of Breed.	From 200: Percentage of Breed.
R.I.R....	55	2	3·6	11	20·0	4	7·3
L.S...............	9	—	—	—	—	—	—
W.A.............	7	—	—	1	14·3	—	—
B.A...............	113	10	8·8	11	9·7	20	17·7
W.L.	286	35	12·2	41	14·3	51	17·8
TOTAL......	470	47	10·0	64	13·6	75	16·0

TABLE VII.—*Mortality during the latest Competition.*

(1) (*a*) *Open Competition.*

Breed.	No. of Hens.	No. of Deaths.	Percentage of Deaths.
White Wyandotte..................	5	—	—
Rhode Island Reds................	55	8	14·5
Light Sussex......................	10	3	30·0
White Australorp..................	10	5	50·0
Black Australorp.......	115	13	11·3
White Leghorn....................	165	21	12·7
TOTAL.....................	360	50	13·9

(*b*) *Breeders' Registers.*

Breed.	No. of Hens.	No. of Deaths.	Percentage of Deaths.
Rhode Island Reds................	60	—	14·5
Light Sussex......................	10	1	10·0
White Australorp..................	10	3	30·0
Black Australorp..................	130	17	13·1
White Leghorn....................	320	34	10·6
TOTAL.....................	530	60	11·3

Table VI permits of a comparison between the average production per hen of four main breeds entered for previous competitions.

(2) Complete Test.

No. of Hens.	No. of Deaths	Percentage Deaths.
890	110	12·3

The mortality shown in Table VII (2) viz., 12·3 per cent. reveals an increase of 0·2 per cent. on that of the previous year.

Mortality During Latest and Previous Competitions.

(a) Open Competition.

Competition.	Year.	No. of Hens.	Deaths.	of Deaths.
First	1926–27	625	28	4·4
Second	1927–28	980	46	4·7
Third	1928–29	875	46	5·9
Fourth	1929–30	1,000	60	6·0
Fifth	1930–31	1,000	42	4·2
Sixth	1931–32	990	61	6·2
Seventh	1932–33	520	46	8·8
Eighth	1933–34	450	44	9·8
Ninth	1934–35	500	28	5·6
Tenth	1935–36	635	60	9·44
Eleventh	1936–37	550	37	6·6
Twelfth	1937–38	495	48	9·69
Thirteenth	1938–39	565	48	8·5
Fourteenth	1939–40	555	62	11·2
Fifteenth	1940–41	625	97	15·5
Sixteenth	1941–42	544	51	10·5
Seventeenth	1942–43	520	79	15·1
Eighteenth	1943–44	680	81	11·9
Nineteenth	1944–45	645	71	11·0
Twentieth	1945–46	615	67	10·9
Twenty-first	1946–47	510	75	14·7
Twenty-second	1947–48	360	50	13·9

(b) Breeders' Register.

Competition	Year.	No. of Hens.	No. of Deaths.	Percentage of Deaths.
First	1934–35	200	11	5·5
Second	1935–36	208	14	6·73
Third	1936–37	130	11	8·4
Fourth	1937–38	100	10	10·0
Fifth	1938–39	150	21	14.0
Sixth	1939–40	150	17	11·3
Seventh	1940–41	120	12	10·0
Eighth	1941–42	108	16	14·8
Ninth	1942–43	80	8	10·0
Tenth	1943–44	190	13	6·8
Eleventh	1944–45	220	18	8·1
Twelfth	1945–46	269	29	10·7
Thirteenth	1946–47	360	31	8·6
Fourteenth	1947–48	530	60	11·3

Post Mortem Examinations.

All hens which died in the course of the contest, were sent to Onderstepoort for examination. According to post-mortem reports received, the deaths were caused by lymphoid leucosis, internal haemorrhage due to fatty degeneration and rupture of the liver, inflammation, cancer, fowl paralysis, nephritis and salpingitis. Copies of these reports were sent to the owner concerned.

Table VI.—*Average Production per Hen.*

Year.	White Leghorns. Number of Hens.	White Leghorns. Average per Hen. A.	B.	C.	Total.	Black Australorps. Number of Hens.	Black Australorps. Average per Hen. A.	B.	C.	Total.
Open Competition—										
1928–29.........	535	204·6	7·5	0·3	212·5	125	195·4	9 7	0·3	205·5
1929–30.........	690	195·9	8·9	0·3	205·2	155	184·9	9·0	0·2	194·2
1930–31.........	572	179·6	15·8	0·7	196·2	156	177·4	12·9	0·6	190·9
1931–32.........	576	168·7	22·9	1·0	192·7	152	150·7	39·2	2·8	192 7
1932–33.........	292	191·0	24·6	1·4	217·0	96	164·1	27·3	2·8	193·9
1933–34.........	244	185·5	22·5	1·2	209·2	96	170·3	30·4	2·0	202·6
1934–35—										
Open Competition	252	190·0	29·6	1·5	222·1	128	185·2	37·2	16·3	224·0
Breeders' Register	104	180·0	33·8	1·7	215·6	16	172·6	30·1	0·9	203·7
1935–36—										
Open Competition	308	175·7	36·3	2·3	214·4	128	151·4	48·2	1·8	201·5
Breeders' Register	96	165·2	38·4	2·1	205·8	56	149·1	53·3	2·6	205·0
1936–37—										
Open Competition	292	191·5	23·3	0·8	215·7	92	191·4	17·5	0·3	209·3
Breeders' Register	48	202·2	14·5	0·6	217·3	40	191·0	19·8	0·9	211·6
1937–38—										
Open Competition	232	117·0	29·2	2·0	208·2	100	136·9	39·3	1·6	177·7
Breeders' Register	48	188·8	20·9	0·6	210·4	24	190·16	32·2	0·45	222 9
1938–39—										
Open Competition	280	193·0	22·0	2·0	217·0	112	181·4	21·7	2·3	205·4
Breeders' Register	80	191·8	20·6	2·5	214·9	32	162·0	12·4	0·6	175·0
1939–40—										
Open Competition	274	183·6	24·9	1·3	209·8	133	180·6	23·9	1·8	206 3
Breeders' Register	170	199·5	25·6	2·9	228·0	126	196·8	18·2	1·1	216·1
1940–41—										
Open Competition	309	175·5	36·9	2·7	215·1	112	171·5	30·7	1·0	203·2
Breeders' Register	62	186·7	37·1	2·1	225·8	46	186·7	23·2	0·7	210·6
1941–42—										
Open Competition	343	181·8	30·3	2·5	214·7	165	165·7	28·2	2·2	196·1
Breeders' Register	77	199·8	20·2	2·3	222·2	23	143·2	8·1	2·1	153·4
1942–43—										
Open Competition	277	180·5	25·1	1·9	207·6	165	173·4	24·0	1·6	199·1
Breeders' Register	55	183·5	17·0	3·2	203·7	17	187·4	29·4	1·1	218·0
1943–44—										
Open Competition	304	175·6	18·1	1·8	195·5	131	182·0	14·4	1·7	198·1
Breeders' Register	122	185·5	13·6	2·0	201·2	39	156·6	8·4	1·0	166·1
1944–45—										
Open Competition	282	185·1	21·2	1·2	207·6	133	188·0	11·2	0·8	200·1
Breeders' Register	156	195·5	21·1	1·5	218·1	29	203·8	22·4	1·4	227·7
1945–46—										
Open Competition	273	190·7	17·6	0·8	209·5	134	188·4	13·0	0·2	202·7
Breeders' Register	147	193·0	19·4	1·0	212·8	64	188·1	17·8	0·6	206·6
1946–47—										
Open Competition	206	187·1	16·1	1·8	205·0	136	179·1	19·3	1·6	200·2
Breeders' Register	174	191·7	12·5	1·1	205·4	98	171·8	19·9	1·8	194·6
1947–48—										
Open Competition	144	180·4	18·4	7·1	206·0	102	176·4	16·3	5·3	198·1
Breeders' Register	286	186·7	14·2	6·3	207·3	113	172·1	16·1	5·5	193·7

Year.	Rhode Island Reds. Number of Hens.	Rhode Island Reds. Average per Hen. A.	B.	C.	Total.	Light Sussex. Number of Hens.	Light Sussex. Average per Hen. A.	B.	C.	Total.
Open Competition—										
1928–29.........	45	177·9	4·3	0·1	182·4	10	148·2	8·2	0·5	156·0
1929–30.........	70	171·4	4·5	0·1	176·9	—	—	—	—	—
1930–31.........	16	149·4	4·3	0·1	157·1	12	116·1	54·3	10·5	181·0
1931–32.........	28	91·5	23·6	0·8	115·6	—	—	—	—	—
1932–33.........	12	136·1	58·9	6·5	201·5	—	—	—	—	—
1933–34.........	8	220·5	7·4	0·4	228·3	—	—	—	—	—
1934–35—										
Open Competition	16	195·1	15·5	0·3	211·0	—	—	—	—	—
Breeders' Register	—	—	—	—	—	—	—	—	—	—
1935–36—										
Open Competition	24	157·9	23·2	0·3	181·5	16	132 0	35 8	1·9	169·7
Breeders' Register	8	128·2	59·7	1·0	189·0	—	—	—	—	—
1936–37—										
Open Competition	40	182·1	25·1	2·2	207·4	12	148·7	33·4	1·7	183·9
Breeders' Register	16	161·7	23·06	0·2	185·06	—	—	—	—	—
1937–38—										
Open Competition	32	139·1	44·8	1·6	185·5	24	99·7	6 8	6·1	168·5
Breeders' Register	8	160·5	50 87	0·62	212·0	—	—	—	—	—
1938–39—										
Open Competition	24	196·3	17·5	0·8	214·6	16	114·3	43·7	7·9	165·9
Breeders' Register	—	—	—	—	—	—	—	—	—	—
1939–40—										
Open Competition	52	182·7	27·7	0·8	211·2	29	137 6	51 8	4·8	194 2
Breeders' Register	—	—	—	—	—	—	—	—	—	—
1940–41—										
Open Competition	48	163·3	34·5	1·8	199·6	42	113·9	42 5	2 2	158·6
Breeders' Register	—	—	—	—	—	—	—	—	—	—
1941–42—										
Open Competition	77	176·0	31·0	1·1	208·1	27	111 7	70·5	6 3	188·6
Breeders' Register	—	—	—	—	—	7	127 2	69 7	3 0	200·0
1942–43—										
Open Competition	70	171·3	17·9	1·0	190·0	27	135·0	39 6	9 3	183·9
Breeders' Register	—	—	—	—	—	—	—	—	—	—
1943–44—										
Open Competition	71	187·6	8·8	1·1	197·5	14	141·6	21·5	3·5	169·7
Breeders' Register	—	—	—	—	—	16	103 6	7·2	2·1	112·9
1944–45—										
Open Competition	85	167·1	21·6	0·7	189·5	15	187 0	8 0	2 0	197 1
Breeders' Register	9	136·0	68 1	2·0	206·1	8	148·3	42·1	1 2	191·7
1945–46—										
Open Competition	87	172·4	25·6	0·4	198·4	18	143 0	10 9	0 6	154·6
Breeders' Register	9	155·3	19 6	0·2	175·2	10	112·0	36 3	0·5	149·4
1946–47—										
Open Competition	50	171·0	13 2	1·5	185·7	15	162·2	23·7	1·2	187·2
Breeders' Register	39	183·5	10·1	0·9	194·5	10	150·1	29·1	4·5	183·7
1947–48—										
Open Competition	47	159·3	22·3	7·1	188·9	7	161·4	9·8	6·0	177·3
Breeders' Register	55	165·9	31·9	7·5	205·2	9	143·3	30 0	4·1	177 4

Conclusions.

From the results of the past competition, it is evident that in future breeders have to pay more attention to—

(1) strong constitution;

(2) the breeding of hens from parents with both high egg production and stamina;

(3) the elimination of families in which cancer occurs;

(4) *egg size* as well as strength of shell; and

(5) the breeding of hens which are free from B.W.D.

"Blue Disease" of Tomatoes:—

[*Continued from page* 336.

when soil is adequately supplied with phosphates. It may be that under these cold conditions, the capacity of the plant to absorb nutrients from the soil is impaired. Growth, particularly of the root system, is so retarded under cold conditions that the plant is apparently unable to take up from the soil sufficient phosphate, and in consequence sugars accumulate in the tissues of the plant and pigmentation normally follows. This condition, unless prolonged by continuous cold weather, is not serious, as the plants, although checked in growth, will automatically right themselves with the advent of warm weather, provided the soil contains sufficient available phosphate.

The whole question of the "lock up" of various forms of phosphatic fertilizers in Lowveld soils is at present receiving attention at the Sub-tropical Horticultural Research Station, Nelspruit.

Provisional Recommendations.

In areas where the response of annual crops to applications of superphosphate has been disappointing, farmers are advised to test out for themselves the efficiency of straight super as compared with a mixture of 1 part super to 2 parts rock phosphate.

Only finely ground rock phosphate should be used. The rock phosphate should have a fairly high citric acid soluble phosphate content. For a short-term crop such as the tomato, phosphatic fertilizers should be applied at planting-out time in the row at the 3 to 4 inch depth, i.e. as near as possible to the major root zone of the plant. Superphosphate used alone should be applied at from 800 to 1,500 lb. per morgen depending on the phosphate requirements of the crop and the degree of "lock up" of phosphate in the soil.

A New Bulletin.

Bulletin No. 284. The Feeding of Farm Animals (1. Dairy Cattle) has been published recently. It is obtainable from the Editor of Publications, Pretoria, at 3d. per copy.

Investigations on the Composition of South African Milk.

V. (a) The Relationships between the Various Constituents of Milk.

S. Bakalor, Dairy Section, Agricultural Research Institute, Pretoria.

PREVIOUS STUDIES in this series have dealt with the percentage composition of milk, and the factors causing variations in this composition. In the present investigation, however, it is proposed to examine the relationships existing between the various constituents of milk in order to determine, for example, whether milk rich in fat must necessarily be rich in S.N.F. (solids-not-fat).

A study made at the Illinois Experimental Station (U.S.A.) of the results of 2,426 analyses of the milk of pure-bred and cross-bred cows, showed that there was a tendensy for the S.N.F., ash and protein contents to rise, as the milk became richer in fat. The lactose content (except in the case of Ayrshire milk) tended to decline, however, with such increases in fat. The S.N.F. as a whole tended to increase as the lactose content increased, but the other S.N.F. constituents, viz. protein and ash, tended to decrease.([8])

, The analyses of more than 100,000 samples of milk produced by suppliers in the New England states of the U.S.A., revealed that for every increase or decrease of 0·1 per cent. in fat content, there was a similar change of about 0·04 per cent. in the S.N.F. There was a slight seasonal variation in this relationship.([7]) For the Illinois data, the corresponding figure for S.N.F. was 0·037 per cent.([10])

In contrast to the above finding, a study of the composition of over 700 samples of mixed milk from 15 herds in England, revealed that for tests up to 8.8 per cent. S.N.F. (the average for all the samples), there was an inclination for fat to decrease as the S.N.F. increased, and vice versa. Above this value for S.N.F. the relationship between the two constituents was, however, positive. From this study there appeared to be an indication that samples abnormally low in S.N.F. were associated with a fat percentage above the average (in this case 3·71 per cent fat).([5])

Local Data for Study.

To ascertain the possible relationships existing between the various constituents in South African milk, a study was made at this Institute of the following data:—

(1) 1,608 analyses of milk supplied by producers to a Pretoria city milk plant during the period August 1944 to July 1945.([1])

(2) Over 1,200 analyses of batches of whole milk received at Bergville condensery over a period of one year.([2])

(3) The annual means for fat and S.N.F. of milk supplied to the Escourt and Franklin Condenseries during the years 1929 to 1945 inclusive.([2])

(4) The monthly variations in composition of Cape Peninsular milk over a period of 15 years.([12])

This study is mainly based on the Pretoria and Bergville data. The Pretoria city milk was analysed at this laboratory for total solids, fat, S.N.F., ash, protein and lactose.[1] The Bergville supplies were analysed only for total solids, fat and S.N.F. A ful years period was taken in each case, in order to make full allowance for seasonal variations. The results obtained from this study are described below.

Fat and the S.N.F.

The changes that occur in the solids content of milk as the fat percentage rises, are indicated in Table I (illustrated by Fig. I).

TABLE I.—*The Changes in the Solids Content of Milk as the Fat Percentage increases.*

	PRETORIA.						BERGVILLE.		
Fat.	Percentage of Total No. of Samples in Group.	Mean Composition.					Percentage of Total No. of Samples in Group.	Mean Composition.	
		Total Solids.	S.N.F.	Ash.	Protein.	Lactose.		Total Solids.	S.N.F.
Per Cent.		Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.		Per Cent.	Per Cent.
2·7	0·3	10·90	8·20	0·700	2·95	4·55	—	—	—
2·8	1·1	11·53	8·73	0·744	3·08	4·89	—	—	—
2·9	1·2	11·49	8·59	0·728	3·08	4·83	—	—	—
3·0	3·1	11·69	8·69	0·743	3·14	4·82	0·1	11·65	8·65
3·1	4·4	11·69	8·59	0·741	3·09	4·77	0·2	11·60	8·50
3·2	9·3	11·83	8·63	0·741	3·16	4·76	0·2	11·65	8·45
3·3	10·5	11·89	8·59	0·743	3·14	4·72	0·2	11·45	8·15
3·4	12·3	12·01	8·61	0·738	3·17	4·71	2·3	11·81	8·41
3·5	12·1	12·07	8·57	0·733	3·17	4·66	12·2	11·97	8·47
3·6	10·9	12·20	8·60	0·732	3·19	4·67	20·2	12·08	8·48
3·7	9·8	12·23	8·53	0·727	3·21	4·60	18·0	12·22	8·52
3·8	9·3	12·40	8·60	0·741	3·21	4·65	15·2	12·35	8·55
3·9	5·6	12·49	8·59	0·723	3·23	4·66	10·1	12·44	8·54
4·0	3·1	12·50	8·50	0·751	3·22	4·53	8·1	12·50	8·50
4·1	2·2	12·62	8·52	0·739	3·28	4·50	5·8	12·69	8·59
4·2	1·9	12·76	8·56	0·730	3·25	4·58	4·4	12·80	8·60
4·3	0·9	12·90	8·60	0·732	3·28	4·61	1·8	12·85	8·55
4·4	0·8	12·83	8·43	0·688	3·29	4·47	0·8	12·98	8·58
4·5	0·5	13·09	8·69	0·625	3·39	4·65	0·4	13·11	8·61
4·6	0·2	13·05	8·55	0·758	3·32	4·47	—	—	—
4·7	—	—	—	—	—	—	—	—	—
4·8	0·3	13·13	8·33	0·745	3·25	4·36	—	—	—
4·9	0·1	13·80	8·90	0·700	3·45	4·74	—	—	—
5·0	0·1	13·75	8·75	0·700	3·45	4·60	—	—	—

For individual tests made throughout the year, no definite trends can be ascertained in S.N.F.-fat and ash-fat relationships. A definite positive relationship will, however, be noted between the annual means for fat and S.N.F. The corresponding changes in the protein and lactose contents are similar to those found in U.S.A. milk, i.e. local milk tends to become richer in the former, and poorer in the latter, constituent as the fat percentage increases. The total solids percentage follows a trend similar to that of the fat.

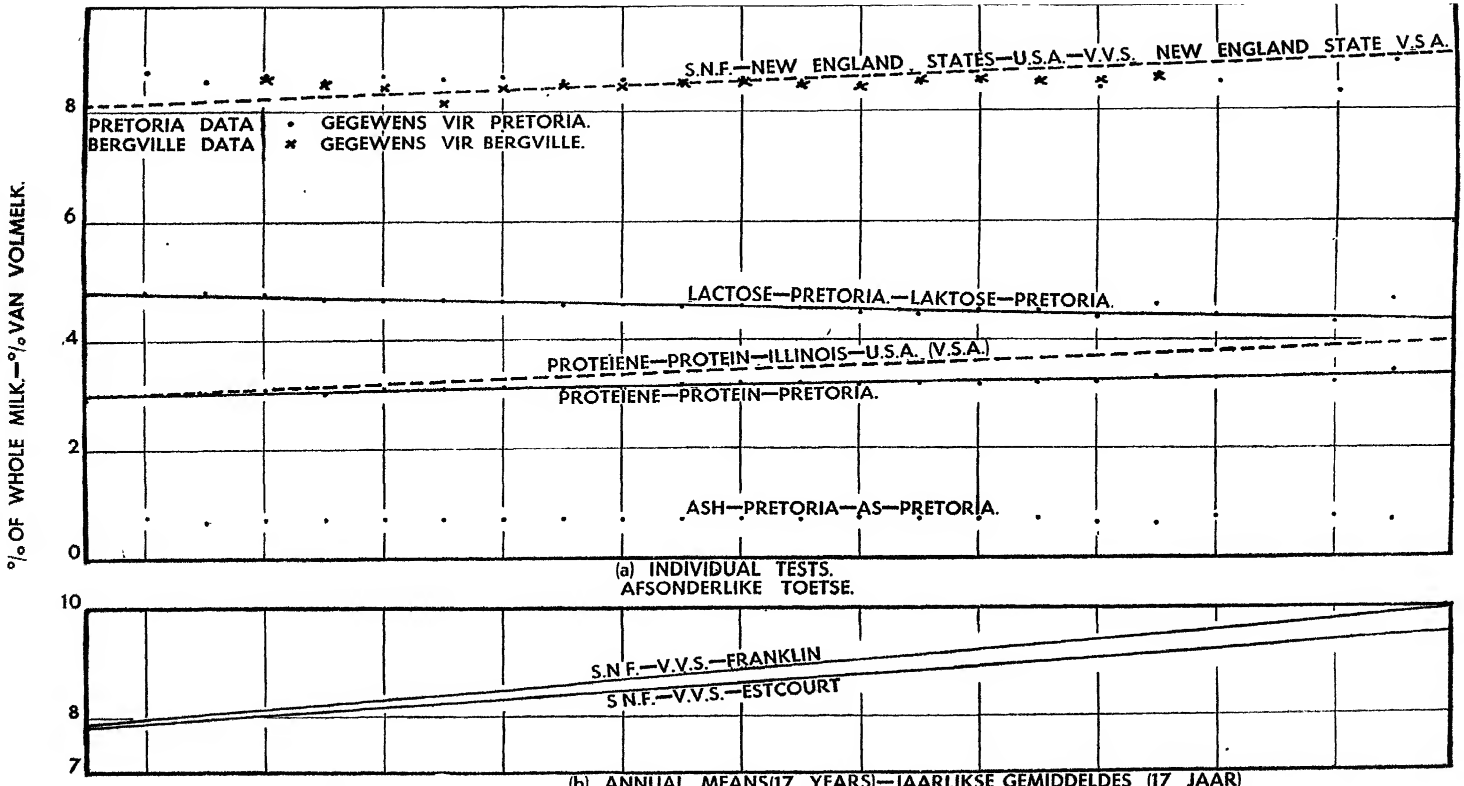


FIG. 1.—*The changes in the S.N.F. as the Fat Content of Milk increases.*—(*N.B.*—The Annual Means for Franklin only range between 3·31 per cent. and 3·52 per cent. fat, and those for Estcourt between 3·43 per cent. and 3·79 per cent. fat. The respective lines have, however, been extended beyond these limits, in order to indicate the trends).

Besides the variations in the percentages of the other constituents which occur as the milk becomes richer in fat, a certain amount of variation in each particular fat group is also found. In Table II is indicated the general S.N.F. range for certain fat groups in which a large proportion of the samples in either of the two areas fell.

TABLE II.—*General Variations in the S.N.F. Content of Milk testing* (a) 3·5 *per cent. Fat* (*Pretoria*),(*b*) 3·6 *per cent. Fat* (*Bergville*).

Area.	Milk Testing.	Range of Composition.				Coefficient of Variability.
		Constituent.	Highest.	Lowest.	Mean.	
			Per Cent.	Per Cent.	Per Cent.	Per Cent.
Pretoria.......	3·5 per cent. fat	S.N.F.........	9·75	7·65	8·57	3·46
		Ash...........	0·925	0·575	0·733	9·00
		Protein.......	3·45	2·74	3·17	3·61
		Lactose.......	5·75	3·75	4·67	5·55
Bergville......	3·6 per cent. fat	S.N.F.........	8·86	8·04	8·48	1·73

A sample of Bergville milk testing 3·6 per cent. fat, could thus contain between 8·04 per cent. and 8·86 per cent. S.N.F. In the Pretoria milk an even wider variation is noted. Of the S.N.F. constituents, the ash varied the most in any fat group. Where definite trends have been demonstrated in Table I (e.g. between protein and fat, and lactose and fat) it is apparent that these particular relationships are strong enough to overshadow any variations (as in Table II) which may occur in a separate fat group.

In Table III (illustrated by Fig. II) another aspect of the S.N.F.-fat and protein-fat relationships is studied viz., the dificiency in the S.N.F. and protein of milk as the fat content rises. There is no legal standard for protein in milk, but for the purposes of this study, 3·10 per cent. has been taken as a level for protein, analogous to the 8·5 per cent. standard for S.N.F. This is a fairly low level, as from Table IV it will be noted that milk testing between 8·3 per cent. and 8·5 per cent S.N.F. has a corresponding protein range of 3·13 to 3·18 per cent. Exactly 24 per cent. gy weight of the Pretoria supplies sampled, tested below this protein standard.(1)

The lack of relationship shown in Table I between the S.N.F. and fat, is reflected in the random variations in deficiency in S.N.F., as the milk becomes richer in fat. What must be disturbing to the local dairyman, however, is the large possible deficiency (about 50 per cent.) in the S.N.F. of milk testing as high as 4·0 per cent or even 4·5 per cent. fat. Indeed, the following are typical analyses of much of the milk from both areas, with a high fat test:—

Fat. *Per Cent.*	*S.N.F.* *Per Cent.*	*Fat.* *Per Cent.*	*S.N.F.* *Per Cent.*
3·8	7·87	4·24	7·95
4·05	8·13	4·20	8·23
4·04	8·23	4·30	8·17
4·15	8·14	4·60	8·39

The fact that milk intended for the city trade is well above the standard for fat, is thus no guarantee that it will be above the corresponding standard for S.N.F.

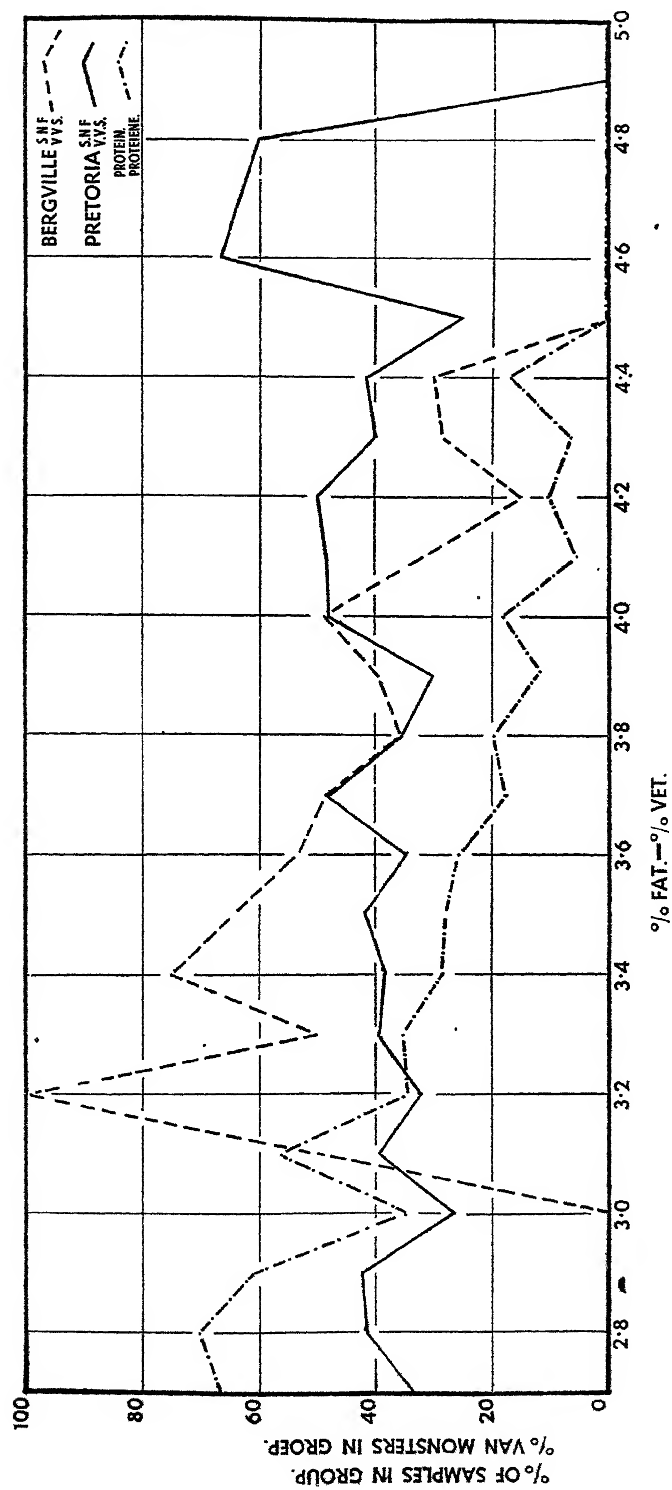


FIG. II.—Deficiencies in the S.N.F. and Protein Contents of Milk, *as the Fat Percentage increases.*

The percentage deficiency of protein in milk shows a definite decline as the fat content rises. No milk, with a fat test higher than 4·4 per cent., tested less than 3·1 per cent. protein. This trend was to be expected from the protein-fat data in Table I.

Factors Influencing the Relationship Between the Fat and S.N.F. Constituents.

Among the most important factors affecting the possible relationships between the fat and the other constituents, are the influence of season, diseases and handling methods.

TABLE III.—*The Deficiency in the S.N.F. Content of Milk as The Fat Content rises.*

Percentage Fat.	Percentage of Samples in Group Testing below :		
	(*a*) 8·5 Per Cent. S.N.F.		(*b*) 3·1 Per Cent. Protein.
	Pretoria.	Bergville.	Pretoria.
2·7	33·3	—	66·7
2·8	41·2	—	70·5
2·9	42·1	—	61·1
3·0	26·5	00·0	34·7
3·1	39·4	50·0	56·3
3·2	32·4	100·0	34·5
3·3	39·3	50·0	35·7
3·4	38·3	75·0	28·1
3·5	42·0	64·7	28·0
3·6	34·5	53·2	25·9
3·7	48·1	48·2	17·3
3·8	35·6	35·6	19·5
3·9	30·0	39·2	11·1
4·0	48·0	49·0	18·0
4·1	48·6	31·9	5·7
4·2	50·0	14·8	10·0
4·3	40·0	28·6	6·7
4·4	41·7	30·0	16·7
4·5	25·0	00·0	00·0
4·6	66·7	—	00·0
4·7	—	—	—
4·8	60·0	—	00·0
4·9	00·0	—	00·0
5·0	00·0	—	00·0

Seasonal changes.—Table IV and Fig. III illustrate the month-to-month changes in the S.N.F. of milk, when the fat content remains fairly constant. The group of samples, testing between 3·40 per cent. and 3·69 per cent. fat, was chosen as being typical of the general supply. This group contained over 35 per cent. of the total number of samples, and the mean for all the Pretoria supplies (3·51 per cent. fat) fell in the middle of this group.

In common with all the supplies sampled during this year [1], the milk in the above group was richest in S.N.F. and lactose in the rainy summer period (November) and richest in protein in late summer and autumn (February and March). The poorest averages for S.N.F., protein and lactose, were found in late winter and early spring (from July onwards). The ash trends were less definite.

From this, it is evident that the amount of S.N.F, or of any of the S.N.F. constituents, which is associated with a particular fat test, can vary from month to month or from season to season. The fat in milk, in all areas of the Union, also exhibits a marked seasonal trend, being, on an average highest in autumn and early winter, and lowest in spring and early summer.(3)

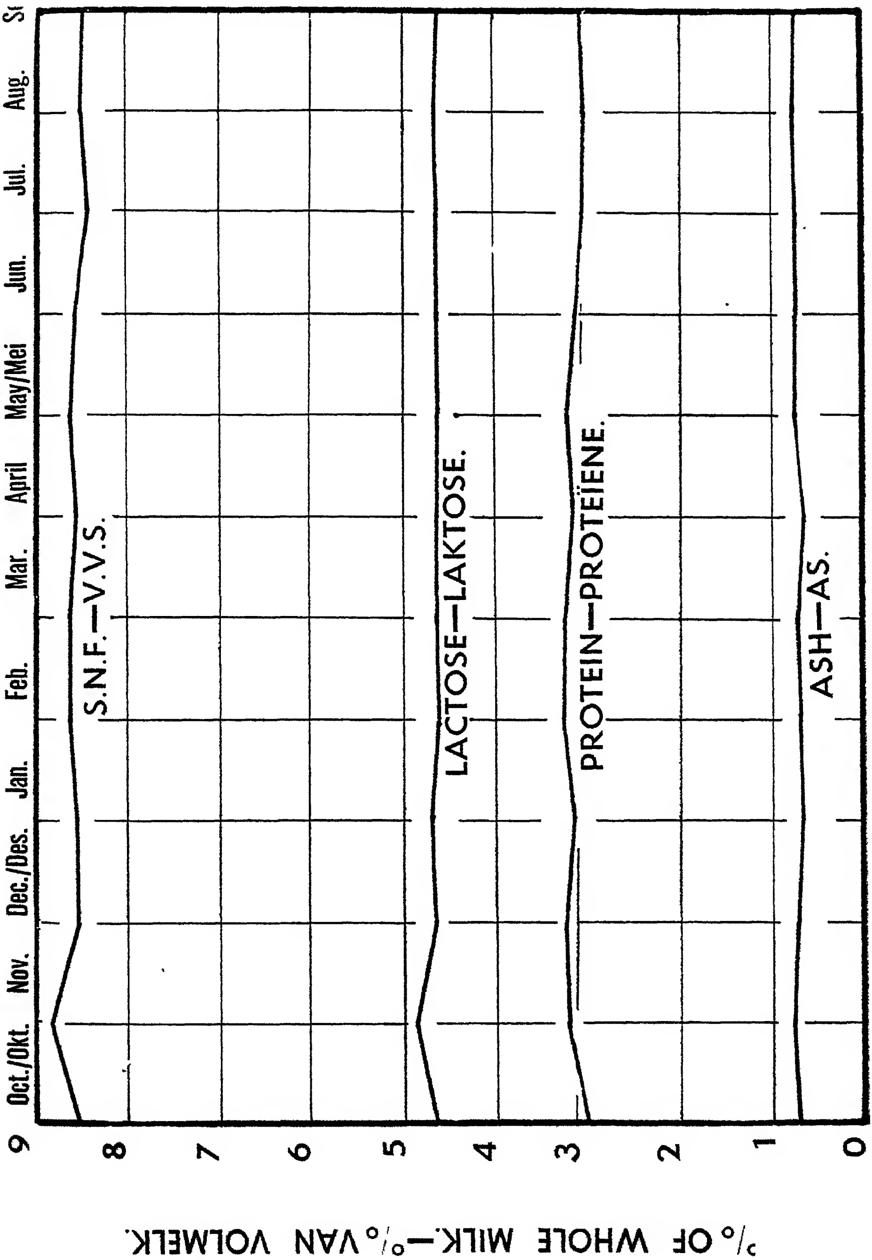


FIG. III.—*Monthly Variations in S.N.F. of Milk testing between* 3·40 *per cent. and* 3·69 *per cent. Fat* (*Pretoria*, 1944–45).

The monthly trends for both protein and fat in Pretoria milk are very similar. Lactose, however, is inclined to be high in the months when fat is low and vice versa. Hence a positive relationship between the protein and fat, and a negative relationship between the lactose and fat contents was to be expected.

TABLE IV.—*Monthly Variation in the S.N.F. Content of milk testing between* 3·40 *per cent and* 3·69 *per cent Fat* (*Pretoria* 1944-1945.)

Month.	Mean Test.			
	S.N.F.	Ash.	Protein.	Lactose.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
October	8·52	0·721	3·13	4·67
November	8·85	0·771	3·21	4·87
December	8·59	0·710	3·24	4·64
January	8·57	0·694	3·18	4·70
February	8·61	0·707	3·28	4·63
March	8·65	0·720	3·24	4·69
April	8·57	0·698	3·19	4·68
May	8·62	0·771	3·21	4·64
June	8·57	0·782	3·16	4·63
July	8·43	0·744	3·05	4·64
August	8·50	0·779	3·03	4·69
September	8·48	0·743	3·08	4·66
Whole Period	8·59	0·735	3·17	4·69

This difference in seasonal trend between the fat and S.N.F. contents of milk in the summer-rainfall area must largely account for their apparent lack of relationship in the individual tests of both Pretoria and Bergville milk. This is emphasised by the strong positive correlation between the annual means for fat and S.N.F. in both Estcourt and Franklin milk.(2) The general level of S.N.F. in the milk of an area over periods of one or several years, appears to be definitely related to the level of the fat. The chemical quality of milk in any area over long periods, is determined by genetic factors (e.g. the quality of dairy animal kept), the persistence of diseases affecting composition, etc. In the Union the average fat content of milk is fairly satisfactory, but the average S.N.F. content is very unsatisfactory. Any factors tending to lower the S.N.F. level of the milk of an area, must in the end cause a lowering of the general fat average. It has been demonstrated that this has actually occurred in the Franklin and Estcourt areas.(2)

The influence of environmental factors on the relationship between the constituents must be emphasised. Although there is an apparent lack of relationship between the individual fat and S.N.F. tests of milk in the two separate portions of the summer-rainfall area (Pretoria and Bergville), it is extremely likely that a close correlation will be found between these two factors in the winter-rainfall area (e.g. the western Cape Province) where the milk reaches its highest averages for both fat and S.N.F. in the winter period.(3)

Effect of Diseases.—The ash or mineral matter in milk can be divided into a " desirable " portion (e.g. the calcium and phosphorous salts) and a " less desirable " portion (chloride). The " desirable " salts are those which are essential in human nutrition, or play an indispensible part in the cheese-making process (e.g. calcium salts). An excess of chloride is an abnormality. It is usually an indication of an udder disorder, such as

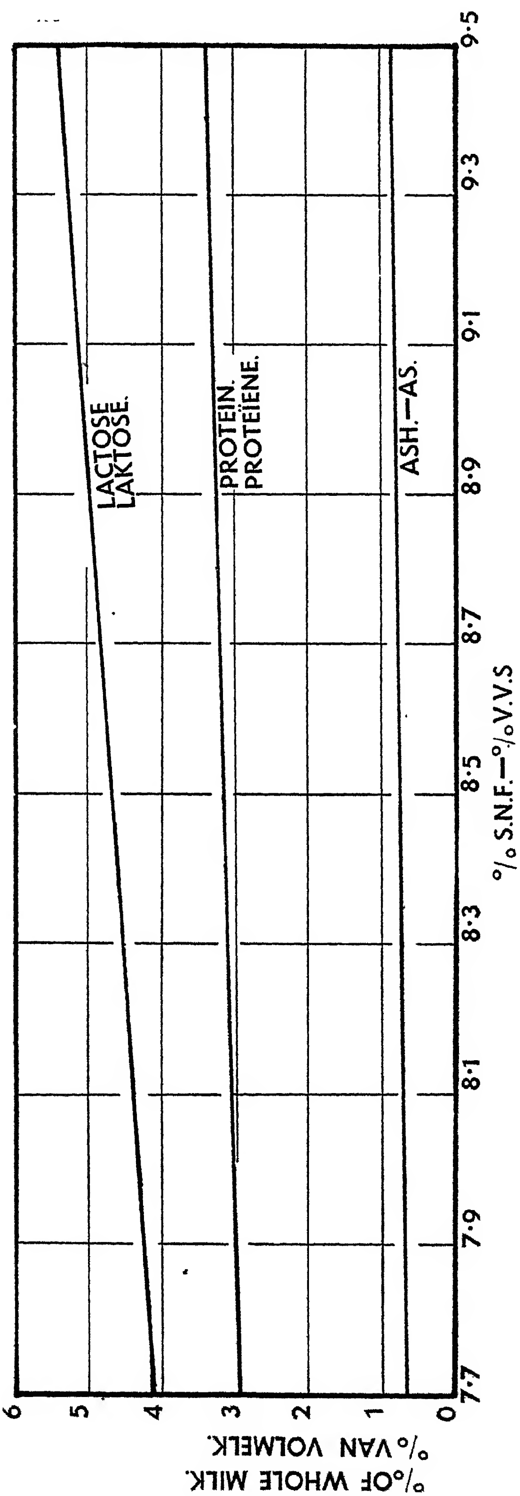


FIG. IV.—Relationship between the S.N.F. as a whole, and the Ash, Protein and Lactose (Pretoria, 1944–45).

mastitis. Any increase in chloride, brought about by mastitis etc., results in a decrease in the lactose content.[4] This is but another example of an inverse relationship between two constituents of milk.

The chloride content of a certain number of the samples of Pretoria commercial milk discussed in this study, as well as of milk from the Institute's Friesland herd, was determined at this laboratory. The following is an extract of the results [4]:—

Percentage Chlorides.

	Friesland Herd.	*Commercial Milk.*	*All Samples.*
Maximum	0·104	0·145	0·145
Minimum	0·072	0·092	0·072
Mean	0·093	0·110	0·098

Commercial milk, coming from herds in which mastitis or other disorders are, as a rule, more prevalent than in the herd of an experimental farm, thus contains more chloride than milk from the latter source.

Strong evidence of mastitis or other udder infection has been found in Pretoria commercial milk throughout the year.[1] As the samples were not analysed regularly for chloride, it was not possible to determine what proportion of the mean ash content per month was made up of this constituent. It has been mentioned that a positive correlation was found between the ash and fat contents of the milk of experimental herds at Illinois, U.S.A.[8] No chloride determinations were made in that particular survey, but it is very likely that the level of chloride in the milk of those herds, was lower than that of local commercial milk.

It may be concluded that if there is a positive relationship between the fat and the "desirable" portion of the ash content in local supplies, it was largely overshadowed by the relatively high chloride content of the milk.

TABLE V.—*Relationship between the S.N.F. as a whole, and the Ash, Protein and Lactose Contents of Milk. (Producers' Supplies, Pretoria 1944-45.)*

S.N.F.	Percentage of Total No. of Samples in Group.	MEAN TEST.		
		Ash.	Protein.	Lactose.
Per Cent.		Per Cent.	Per Cent.	Per Cent.
7·7	0·4	0·690	2·92	4·14
7·8	1·2	0·690	2·98	4·18
7·9	0·7	0·740	3·02	4·19
8·0	2·1	0·700	3·02	4·33
8·1	4·0	0·700	3·05	4·40
8·2	6·3	0·710	3·09	4·45
8·3	10·2	0·719	3·13	4·50
8·4	13·3	0·720	3·14	4·59
8·5	12·8	0·720	3·18	4·65
8·6	14·4	0·728	3·21	4·71
8·7	12·0	0·730	3·24	4·78
8·8	9·1	0·740	3·26	4·85
8·9	5·2	0·759	3·26	4·93
9·0	3·9	0·754	3·30	5·00
9·1	2·4	0·770	3·30	5·08
9·2	0·8	0·774	3·27	5·21
9·3	0·8	0·796	3·30	5·25
9·4	0·2	0·800	3·35	5·31
9·5	0·2	0·810	3·35	5·39

[Continued on page 356.

Improvement of Wheat Varieties.

Dr. P. J. R. de Villiers, Stellenbosch-Elsenburg College of Agriculture.

WHEAT is undoubtedly the most important of our winter cereals, because it plays such an important rôle as food for man. A very difficult problem which presents itself in the cultivation of wheat is the so-called deterioration of certain varieties after cultivation for a few years. Actually it is not the varieties which deteriorate in any way, but new diseases are always appearing, particularly forms of rust which militate against successful cultivation of wheat. The only way to overcome this difficulty is to breed new varieties with a higher degree of resistance to, or immunity, from these diseases. Resistance to diseases is, however, not the only factor to be considered in breeding new wheat varieties. Before the wheat breeder makes any effort to produce a specific improved wheat variety, he should be very clear in his own mind as to what he has in view in breeding. The plant breeder should aim at the production of a wheat variety with the following characters:—

(1) Immunity from such diseases as foot rot, stem rust, leaf rust, speckled leaf blotch and *Septoria nodorum*.

(2) Very stout stalks.

(3) Early or late maturity according to requirements peculiar to the areas where it is to be grown.

(4) A good baking quality.

(5) The maximum yield per morgen.

(6) A capacity for yielding a reasonably good crop on poor soil.

(7) Drought resistance.

To produce a variety complying with all the requirements is, however, no easy matter. Before any hybridisation of different varieties is effected, it is essential that the breeder should have a thorough knowledge of his breeding material, otherwise the whole breeding programme will be of a purely speculative nature. The plant breeder must, for example, have a knowledge of the baking quality, the different forms of rust and other diseases to which the varieties are resistant, as well as all the other desirable characters mentioned above. Efforts are then made to combine in an individual as many as possible of these desirable characters. A single hybrid may often consist of a combination of six or more varieties.

The seed from this hybrid is then allowed to segregate for about eight years. After this period it may be accepted with a fair degree of certainty that the greatest percentage of plants will breed true to type for all their characters. Selection is then applied, and the seeds from each selected plant are transplanted in rows to see if they breed true to type. At this stage they are carefully examined and then it is decided which of the newly bred varieties should be chosen for testing against already existing varieties.

If the seed gives satisfactory results, the quantity is increased for distribution among farmers. As far as rust resistance, yield and baking quality are concerned, fairly satisfactory results may be obtained in this way. The big problem, however, that the plant breeder has to face in breeding a new wheat variety is the consideration of such factors as foot rot, drought resistance and the capacity to do well in poor soil. Since

no single wheat variety, immune from foot rot, exists, the plant breeder is compelled to take an entirely different course in an effort to meet this urgent requirement.

Certain varieties of rye, for example, have shown a fairly good resistance to foot rot, and, in addition, rye thrives much better on poor sandy soil than wheat. Efforts have therefore been made to combine these favourable characters by means of Wheat-Rye hybridisation. In such wide crossings, however, another difficulty arises, viz., sterility. Success has, however, been achieved in eliminating sterility by treating the young plants with a chemical, called colchicine. This, however, requires an involved technique, and an exceedingly large number of plants must be treated before there are any positive results.

Agropyron x wheat crossings were also made with a view to establishing drought resistance and other desirable characters. Here again, just as in the case of wheat x rye hybrids, sterility presents itself. Workers have succeeded in producing hybrids of wheat x rye and agropyron x wheat, i.e. a hybrid possessing the characters of wheat, rye and agropyron. Work in this direction is being continued, and there are indications that favourable results may be expected.

Investigations on the Composition of South African Milk:–

[*Continued from page* 354.

Effect of Malpractices during Handling.—If milk is adulterated with water, the relative amounts of the various solid constituents will not alter. Such milk will only be poorer in these solids. If, however, skimming occurs, i.e. a portion of the fat is removed, the S.N.F., protein, etc., will increase abnormally in relation to the fat. Very high S.N.F. or protein tests associated with comparatively low fat tests have been shown to be typical of partially-skimmed milk. There is no doubt that skimming to some extent increased the average amount of S.N.F. or protein in the lower fat groups of Table I.

S.N.F. and the S.N.F. Constituents.

The changes occurring in the ash, protein and lactose contents of milk, when the S.N.F. content increases, are shown in Table V and Fig. IV.

In all cases a strong positive relationship is found, despite any difference in the seasonal trend of separate constituents e.g. protein and lactose.

(A subsequent article on this subject will deal with the percentage ratios of other constituents to that of fat in the milk.)

The Farm Home.

(A section devoted mainly to the interests of Farm Women.)

Citrus Jelly and Marmalade.

(Miss Bettie van Deventer, Senior Home Economics Officer, Department of Agriculture, Pretoria.)

Citrus Jelly.

CITRUS JELLY is made from the juice extracted from citrus fruit. It should be a clear, bright transparent and palatable product. The jelly mass should quiver, not flow; the texture must be so tender that it can be cut easily with a spoon, and yet so firm that the angles thus produced will retain their shape. It should not be syrupy, neither gummy, sticky, tough, nor brittle.

Marmalade.

There are two types of citrus marmalade:

(*a*) *Golden Shred Marmalade*: This type resembles citrus jelly in all respects, excepting that very fine shreds of the yellow skin are added at the end of the boiling process. These shreds should be cut from the outer yellow rind, which must first be parboiled so that the texture will be tender, but not mashy. No white membrane should be attached to the rind. Only a small quantity of shreds should be added and these must be in suspension in the jelly mass, and should not rise to the top.

(*b*) *The second type of marmalade* is made from the entire fruit including the pulp and peel, which should be sliced very fine. The pulp and sliced peel must be evenly distributed throughout the jelly mass. Marmalade must be jelly-like in consistency, not too stiff; the pieces of fruit must be tender but not mashy. The flavour may be bitter or sweet according to the type required. If sweet, the marmalade must not have lost the characteristic citrus flavour.

In the preparation of jelly and marmalade it is essential to use only fresh fruit which have just turned ripe, because such fruit will be rich in pectin, and thus yield a good quality product.

Pectin and acid are very important constituents in the making of jelly and marmalade.

If a sufficient quantity of pectin is present, the fruit juice can be made into jelly; if insufficient it is impossible to transform the juice into a good quality jelly.

The amount of acid present in the juice has also a bearing on the jellying qualities of the juice. It is therefore always desirable to add a small amount of lemon juice to ensure that sufficient acid is present.

To Test for Pectin.

(*a*) *Methylated spirits tets:* The presence of pectin in juice can be determined by mixing the fruit juice with methylated spirits. Pour one tablespoon of fruit juice into a glass and allow to cool; to this add two to three tablespoons of methylated spirits and leave for a few moments. Do not stir. A gelatinous mass will appear in the liquid, which is an

indication of the quantity of pectin present, and the amount of sugar required is determined accordingly. If there is a firm clot, then one cup of sugar will be necessary for one cup of juice, if two clots are formed, use ¾ cup of sugar for one cup of juice. If only a number of small clots result, the juice will not produce a good quality jelly and more pectin-rich juice should be added.

(*b*) *Epsom Salt Test:* This test can also be applied to determine the jellying quality of the juice. Combine one tablespoon of fruit juice, one teaspoon sugar and 1½ teaspoons Epsom salt. Stir until the sugar and salt are dissolved. Let it stand for 20 minutes. If a solid mass forms then the juice will make a satisfactory jelly.

The rules for making jelly and marmalade are simple, and if they are followed carefully there will be no failures.

Three ingredients are needed for a perfect jelly, viz. pectin, acid and sugar, and each must be present in the right proportion.

The fruit juice for jelly making must contain sufficient quantities of pectain and acid. If the juice does not contain the required pectin (determined by pectin test) it can be boiled down, or juice extracted from pectin-rich fruit can be added. Commercial pectin is sometimes used. This product is obtainable in liquid or powder form and is made from natural fruit pectin. If used, the directions should be followed very carefully: there should be no guesswork. Citrus fruits are, however, all fairly rich in pectin and it should not be necessary to use commercial pectin for jelly making.

Steps in Jelly-making.

Extracting the juice. Select only sound fruit that is just ripe enough for flavour. One variety can be used, but two or more can be combined for flavour.

Pips as well as portions of the white membrane must be removed and soaked separately.

Slice the fruit pulp and skin. The juice may be extracted previously and kept separate. Cover the sliced fruit with water and leave for a few hours. Then simmer gently for a period in order to extract the maximum amount of juice. Strain through a very thick wet cloth or cone-shaped jelly bag. The straining will take quite a time. Then add the liquid strained from the pips and also the extracted juice. Bring to the boil and strain again. Do the pectin test to determine the quantity of sugar required.

It is always advisable to make jelly in small batches, say four to six cups at a time.

Use a wide flat-bottomed saucepan and bring the measured juice to the boil, and boil for five minutes. Warm the required sugar in an oven and add. Bring to a full rolling boil rapidly, and boil to the jelly stage.

The jelly test: Dip a spoon in the syrup and let it run off the side of the spoon. At first it will run off rapidly in a single stream, later it will form two streams, and when these merge to form a sheet which shears away from the edge of the spoon, making a clean break, the jelly has cooked long enough.

A sugar thermometer can be used as a check, but it is wise to make the spoon-test as well. The thermometer will indicate about 219°-222° F. When this stage is reached remove the jelly from the heat and skim at once.

Filling the Bottles.

Use long narrow bottles, such as honey jars, for jellies. The bottles must be perfectly clean. Place the bottles on a wooden rack in a moderate

oven. Pour the hot jelly into the warm bottles, using a ladle or small funnel. Pour gently so that no air bubbles wil from. Fill the bottles to within ½ inch from the top.

Pour a layer of paraffin wax (melted over hot water) over the top.

The method described for jelly making also applies to golden shred jelly.

The shreds are prepared as follows:—

(*a*) Boil large pieces of skin until tender. Then carefully scoop out the white membrane, leaving only the jellow rind. Cut into very thin shreds with a razor blade.

(*b*)Pare off the jellow rind, taking care. that none of the white membrane is left attached. Boil until soft and cut very thin with a razor blade or pair of scissors.

Add the shreds to the jelly a few minutes before the jelly stage is reached.

Marmalade.

In preparing fruit for marmalade, the entire fruit is sliced very fine. The pips and centre white are removed and soaked separately. Add two to three cups of water for every cup of pulp. Soak overnight, or for a few hours. Then bring to the boil and boil until the fruit is tender, not mashy.

Do the pectin test, using the required quantities of juice and spirits. Determine the required quantity of sugar and proceed as for jelly.

In making marmalade it is well to remember that pampelmoes, grapefruit, citrons and seville oranges become transparent after boiling, whereas oranges, lemons and naartjies do not. Furthermore, two or more of these varieties can be used together.

Basic Recipes.

Orange marmalade (Bitter)

Six Seville oranges; three lemons; three sweet oranges; sugar and water.

Shred the fruit finely. Remove the pips, cover with water and leave to soak. Measure the fruit pulp and add two to three cups of water for each cup of pulp. Leave overnight, or for a few hours and then boil the fruit in the water until tender. Add the liquid obtained from the seeds and test for pectin as described, and then add the required amount of sugar. Boil rapidly until the marmalade falls from the spoon in flakes. Then bottle.

Grapefruit marmalade.

Three grapefruit; four oranges (juice only); sugar and water.

Peel and quarter the grapefruit, and remove most of the white membrane and soak this separately. Slice the grapefruit and cover with water. Extract the juice from the oranges, slice the orange peels and cover with water. Bring to the boil and strain. Add to sliced grapefruit and boil until fruit is tender. Add orange juice and bring to boil. Do the pectin test. Add sugar and proceed as described above.

Sweet-Orange Marmalade.

Six oranges; two lemons; sugar and water.

Slice the fruit very fine, remove pips and soak separately. Cover the fruit with water (approximately two cups water for one cup of pulp). Leave for a few hours; add the water strained from the pips, and boil until tender but not mashy.

Do the pectin test and proceed as described.

Golden shred Marmalade.

Extract the juice from the fruit, then slice the fruit and cover with water. Leave overnight or for a few hours. Soak the pips separately. Bring the sliced fruit to the boil and boil until the fruit is tender. Strain through a thick cloth or jelly bag. The straining will take quite a time. Add the juice and liquid from the pips to the strained juice and bring to the boil. Boil for five minutes and strain again. Then do the pectin test to determine the quantity of sugar required. Add the sugar, bring to the boil rapidly and strain again. Then boil rapidly to the jelly stage. Add the parboiled shreds just before the jelly is done.

Common Faults in Jelly and Marmalade.

Cloudy jelly.—Cloudiness may be caused by overcooking before the sugar is added; by not straining the juice properly; by not skimming thoroughly; or by letting the jelly stand too long before pouring in into the bottles.

Crystals.—Crystals may form if jelly contains too much sugar and not enough acid.

Gummy jelly.—This condition is caused by overcooking.

Tough firm jelly.—This is caused if too little sugar has been used, or the juice and sugar have cooked beyond the jelly stage.

Mouldy jelly.—Jelly may ferment if exposed to the air too long before it is protected by paraffin, or if the paraffin loosens during storage.

Soft syrupy jelly.—If the juice does not contain enough pectin, or the syrup is not cooked long enough, the jelly will be soft and syrupy.

Please Note.

"Duck Farming", Bulletin No. 248, which was out of print for a time, has been reprinted and is now obtainable from the Editor ot Publications, Pretoria. Price 6d. per copy.

Karakul Sheep for Sale.

33 Karakul and 20 Karakul-Persian Crossbred Sheep will be sold by public auction at the Grootfontein College of Agriculture, Middelburg, Cape, on Tuesday, 20th July, 1948, at 10 a.m.

13 Karakul rams.
20 Karakul ewes.
20 Persian Crossbred ewes.

Further particulars obtainable from the Principal of the above-mentioned College.

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[*Photo on Cover*: Glen Students at a Lecture on Dairy Cattle.]

G.P.-S.1445—1948-9—8,300.

FARMING IN SOUTH ... AFRICA

VOL. 23 JUNE 1948 No. 267

Editorial:

Stabilize Our Agriculture.

THE farmer has a very great responsibility to carry in the building up of our nation. It is to him that one looks for the production of our food supplies. In order to have a strong and virile people, provision must be made for its proper feeding. It is especially important, indeed imperative, that there should be a plentiful supply of essential foods, such as milk, eggs, dairy products, fruit, etc., which will ensure that no section of the people shall be undernourished. With a growing population and, consequently, an increase in the total requirements of the country it has been found that it is by no means an uncommon occurrence to be faced with shortages of essential foods. Attention has from time to time been directed to these situations, and in most instances encouraging responses in production have been attained. In this response to the demand, the producer naturally expects and, as a matter of fact, is entitled to a reasonable compensation for his efforts. This, one finds, he did receive during the war and post-war years, since price levels were fairly high and, generally speaking, it may be accepted that the farming community has done reasonably well financially and has obtained good returns for its labour and investments during recent years.

In these circumstances there may be a tendency to arrive at the conclusion that, providing prices are good, the food requirements of the people will be forthcoming; and it is in respect of such a conclusion that a word of warning at this stage may not be out of place.

In analysing the position one finds that the levels of production and yields per unit in South Africa have not been very high. In fact, in many instances yields have been very poor indeed and unsatisfactory. The question has frequently been raised why this is so. Is it a matter of poor fertility of soils, unfavourable climatic conditions, poor type of animals, inefficient management or lack of improved farming methods or wrong farming systems? In a short article of this nature full and satisfactory replies cannot be given to these questions. In general, it may be stated that any one of these factors may be responsible for our relatively poor output per unit. More frequently it is caused by a combination of these factors, and in the main our poor production and low yields may be ascribed to wrong farming systems and incorrect methods. We do not keep in line or give sufficient attention to the climatic conditions and natural resources of the regions in which we are farming. The tendency is, on the one hand, to overtax the soil and natural vegetation by overstocking, and to overlook the need for making good what has been removed; on the other hand, our methods often leave much to be desired and we do not apply the knowledge which is available and placed at our disposal. Experimentally it has been proved repeatedly that considerably higher yields can be obtained in farming operations if better methods are used. The results obtained at experiment stations and

research institutions are available to all producers, and one would like to see that the fullest use is made of our experiment stations and the work which is being done there. It is felt that by working in close co-operation with research institutes, the farming community will gain valuable knowledge which can be applied in practice and which will result in a material increase in production. There is no doubt that by using the knowledge which is at our disposal, increased production can be procured.

At the present stage of our agricultural development, the time is opportune to take stock of the position and give serious attention to the stabilization of our farming systems and methods. In order to eliminate malnutrition and to feed our people satisfactorily the production of essential foods must be increased. At the same time the soil and the veld must not be depleted in this effort. It must be borne in mind that, agriculturally, South Africa is not a rich country and that the fertility of the soil must be closely guarded, maintained and built up so that future generations will not suffer but will be able to make a living on it. There should be no exploitation under any circumstances, and both soil and veld must be conserved at all costs. This can be done if our methods are sound and if we make good what we remove. By stabilizing farming operations, the future will be safeguarded and less favourable times will be met with fewer repercussions.

(H. B. Davel, Director of the Agricultural Research Institute, Pretoria.)

Apparatus for the Application of Insecticides.

"*Laboratory Apparatus and Technique for the Evaluation of the Toxicity and Adhesiveness of Insecticides*", (Sc. Bul. 267, by B. K. Petty, Insecticide Entomologist, Division of Entomology, Pretoria).—In this publication a description is given of three types of laboratory apparatus, namely:—

1. An apparatus for the application of insecticidal dusts whereby they can be quickly and accurately applied and with which any desired weight of material can be deposited per unit area. The apparatus is designed for the evaluation of the toxicity of contact and stomach poisons and can also be used for the determination of the effective duration of insecticides with residual action. A formula is given whereby pounds per acre may be calculated from laboratory applications of insecticides.

2. An apparatus for the quick and accurate application of contact sprays. It may be used for insecticides with a rapid "knock-down" or residual action. Figures are given which serve to indicate the degree of accuracy that can be obtained and what correlation exists between deposit obtained in relation to the volume of liquid sprayed.

3. An apparatus for testing the adhesiveness of insecticidal dusts whereby the relative adhesive values of insecticides on different types of foliage may be determined. Tables are given illustrating the degree of accuracy which may be expected with the use of this apparatus.

Copies of this bulletin are obtainable from the Chief, Division of Entomology, P.O. Box 513, Pretoria. Price 3d. prepaid.

Wild-Life Utilization in Agriculture.

R. W. Rand, Biologist, Government Guano Islands.

LAND-USE, dating back to the opening up of virgin soil to agricultural enterprise and the more recent activities which are now mainly rehabilitatory and fall within the sphere of soil conservation, is generally associated with wild-life worth in one form or another. There is also a growing tendency to view co-operation with existing wild-life as a necessary concomitant to success or failure of any long-term policy involving land utilization. The realization that wild-life can be scientifically managed and exploited to the ultimate benefit of man, is tending to the view that many of the preconceived notions bear investigation and possible adjustment, and that wild-life is a factor which should not be endangered by whimsical opinion or superficial judgment.

FIGURE 1.—Part of penguin flats. Possession Island.

Birds, particularly, are liable to man's depredations, and more so to the wholesale destruction of suitable habitats which so often accompanies foolish land use. The rôle of birdprotection as resting solely on the safeguarding of individuals without the maintenance of their habitat, is being replaced by a sounder policy of gradually restoring, in conjunction with schemes of land reclamation, suitable areas where wild-life can find sanctuary and be of service in one way or another. Thus conservation practices may aim at preserving the soil by introducing methods of tillage which are based upon contour ploughing, strip cropping, etc. These methods inevitably produce cover for small birds and other wildlife, the habits of which make them valuable assets to the farm.

The Guano Islands.

A particularly illustrative example of the conservation of a natural resource and its judicious exploitation, is seen in the present-day guano

industry, centred about the islands lying off our coast. The constant demand for this guano is an indication of its value as a plant fertilizer.

A variety of large sea-birds frequent many small islands scattered round the coast of South and South-West Africa. These islands are fairly isolated, generally not subjected to heavy rainfall, and provide admirable breeding grounds for the myriads of birds constantly ranging round the coast. They are thus geographically eminently suitable for the deposition and preservation of guano, and the discovery, just over a hundred years ago, of this hidden wealth of fertilizer deposits has led to the protection and controlled exploitation of the birds, which had immediate and far-reaching results.

Ruthless Exploitation.

Prior to the unification of responsibility for extraction of guano and general care of the islands, guano-collecting was originally resorted to by chartered ships fitted out by enterprising Liverpool merchants. Crews were landed at the islands and loaded their ships to capacity, their turn being taken by others waiting off-shore. The "Guano Boom", which

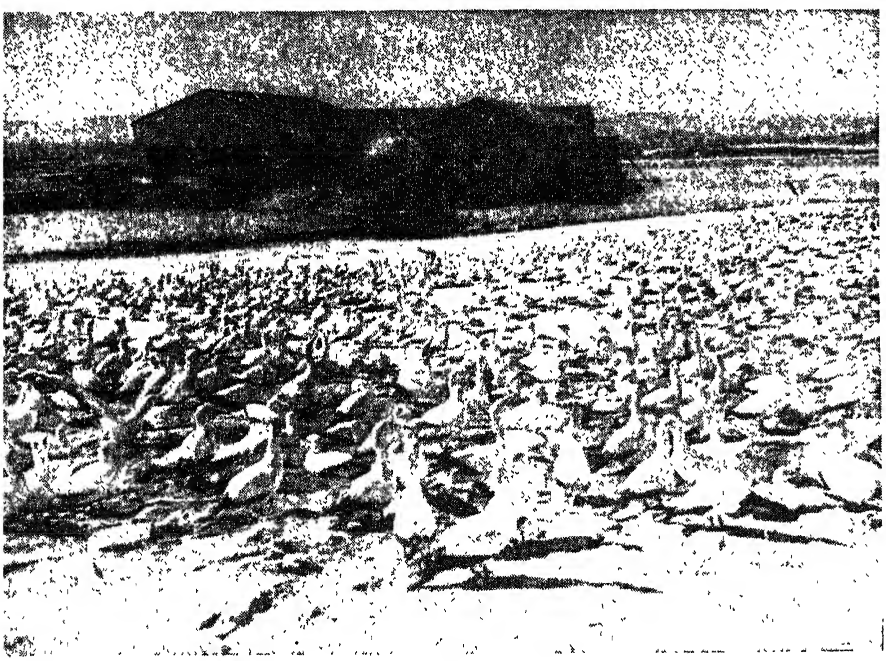


FIGURE 2.—Gannets at commencement of breeding season. Guano shed in background. Possession Island.

centred especially about the islands lying off the South-West African coast, soon exhausted accumulated deposits and threw the islands open to lawlessness which had serious repercussions on the birds. On Ichaboe Island, during this period, about 90,000 tons of guano were removed by April 1845, barely a year after the deposit had been discovered; the remaining estimated 100,000 tons was all removed six months later. The islands were then "ceded" to private firms who, investing in the islands, carefully built up stocks by rigidly protecting the birds. This state of affairs soon excited the cupidity of others, and a system of private ownership was maintained by force of arms. Conditions degenerated to such an extent that the birds were often driven off or killed

to prevent possible harvesting of the guano by rival parties. Disputes were finally settled by formal annexation of all the islands, first in 1861 and later in 1866, and claims by various firms were settled by compensation from the Cape Government. The islands were then put up to public competition under a lease of 14 years. Malagas and adjacent islands in Saldanha Bay, however, were placed under government supervision immediately on the discovery of guano there in 1844. A system of issuing licences to ships loading at the island was instituted and controlled collecting of guano enforced. Within six months 45,655 tons of guano were removed, and the revenue derived by the government on the licence fee of 20s. per registered ton was not inconsiderable. Facilities for loading were erected and the orderliness of arrangements contrasted rather sharply with conditions that had existed on the other islands.

Protection of Bird Life on the Islands.

After the disappearance of guano stocks, more regard was paid to the protection of the birds to ensure as large an annual crop as was possible. Private firms continued to collect guano under the lease system, until management of all the islands finally passed into the hands of the

FIGURE 3.—Guano-collecting at end of breeding season: Gannets still occupying nesting area. Malagas Island.

government. Protection of the birds had never been adequately realized, partly because their eggs continued to be collected or they were eagerly sought after by fishermen as bait for crayfish. Today, more rigorous measures have been adopted in the enforcement of protection against molestation, and the islands are all permanently manned by officials. The present extraction policy is perforce dependent more upon the habits of the breeding birds and less upon the dictates of time and quick profits; a steady but continual supply of fertilizer is ensured, and steps are taken to increase this by protecting the islands and birds, and by conserving

as much of the guano deposited as possible by means of protective walls and platforms.

Different Species of Guano-producing Birds.

The chief guano-producing birds are the penguin (pikkewyn), gannet (malagas) and cormorant (duiker)—different species all of which show widely divergent behaviour. Nevertheless, certain traits in common have facilitated their judicious exploitation. They are, all but to a varying degree, social birds which usually breed in large colonies during the summer months. The breeding season is well-defined; the gannets and cormorants vacating their nesting areas at the completion of breeding in February or March, the penguin colonies similarly show a depletion in numbers as the birds forage out to sea for long periods after the chicks have been fledged. The latter species shows anomalous behaviour in

FIGURE 4.—Collecting guano : A few birds still frequent the nesting area. Malagas Island.

breeding twice a year (March and August) and raising two or more broods of chicks. Activities are thus permitted on the breeding area without the ill-effects of interference on the birds themselves.

Nesting and Breeding Habits.

Although the colonies are often sited on flat sandy areas, the social nesting proclivities of the birds extend to rocky islands where they nest indifferently in mixed flocks on the bare surface or high features. The latter habitat results in the deposition of high-grade and pure guano. The main factor influencing habitat selection seems to be absolute non-interference over the critical breeding season. Nests are often peremptorily deserted if subjected to intrusion during the incubation period. The colonial nesting habits of the birds result in huge aggregations of tightly packed nests covering relatively large areas. Each nest lies adjacent to its neighbours, and territory is restricted to the narrow

surrounding of the nest. Such collections of closely sited guano-covered nests greatly facilitate the removal of the guano in the subsequent extraction period.

Nesting material often consists of debris from the colony itself (feathers especially), or seaweed and other matter from the intertidal zone. The removal of this foreign matter necessitates sieving the guano after is has been removed from the colony area. Where possible, the nesting area is paved, thus preventing admixture with sand or stones.

The guano birds are all relatively slow breeders, reaching maturity in two or more years. Clutch size varies among the species, but tends to be low; thus the gannets produce only one egg annually and the penguins lay clutches of two eggs which can be replaced on destruction of the first pair. The cormorants lay two or three eggs, but seldom fledge more than two chicks. The chicks are all voracious feeders which

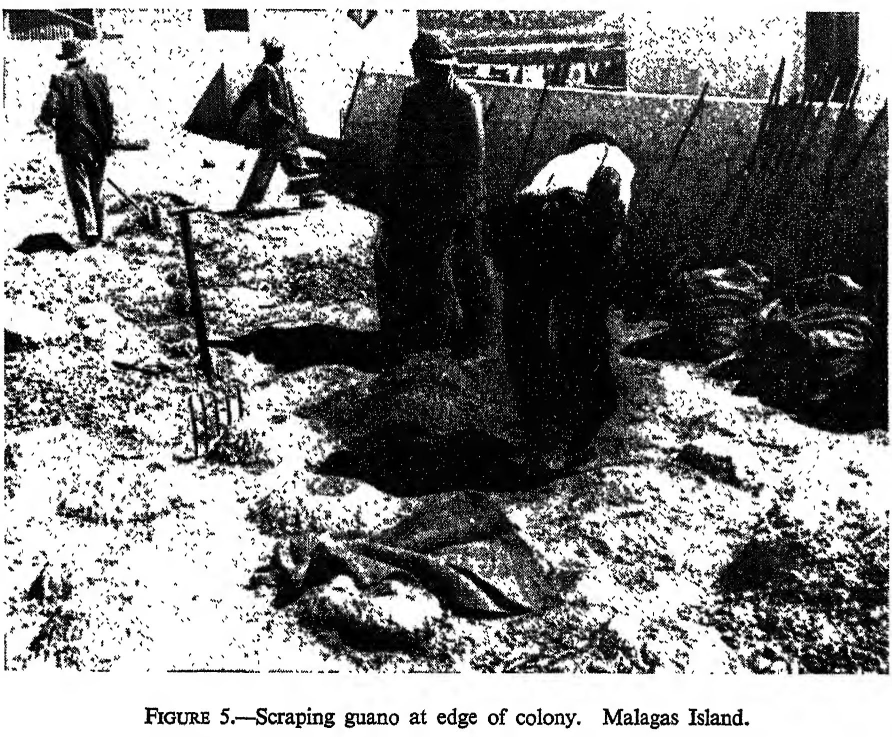


FIGURE 5.—Scraping guano at edge of colony. Malagas Island.

remain in the nest for an extended period, when they are fed by the parent. This characteristic helplessness is eminently suitable for the deposition and accumulation of guano at the nest, and the young birds are indeed the most important guano producers. The accumulated deposit can be conveniently collected at a subsequent date when the juvenile bird has left the nest.

Colony Conduct.

The bionomics of the various colonies are interesting. Generally the nest area is occupied by the main mass of paired (breeding) birds, but a high percentage of this population consists of non-breeding individuals which contribute little to the guano crop. These unemployed birds are either unmated or individuals who have lost their mates and are seeking others. Frequently these non-breeding birds form large roosting colonies of their own, some distance from the main colony. Immatures

are seldom seen in the colonies. Courtship activities at the start of breeding result in many birds occupying the colony area; these numbers fluctuate considerably with the start of incubation and the absence of one partner at sea over extended periods. The birds seldom spend more than a few days (usually one or two) at sea before returning to relieve the partner incubating or safeguarding the chicks. Failure to return may result in nest desertion.

Food Supplies.

The birds feed exclusively on marine life; fish, crustacea and other forms. The feeding grounds may be in the vicinity of the island, or else the birds range considerable distances to and fro along the coast. The abundance of marine life, associated with the cold upwelling Benguella current which sweeps up the coast, is responsible for the bird populations resorting to the islands. Fluctuations in fish and other forms often have

FIGURE 6.—Gannet flats: Birds commencing breeding activities on a white cement-covered area. Possession Island.

serious repercussions on the bird colonies, causing nest desertions and a high mortality among the fledglings and even adults. Epidemics are rare, but have occurred in the past, with disastrous effects on the guano crop.

Assuring the Guano Supply.

Wise exploitation of the birds has ensured a steady yield of guano, which shows little fluctuation. A policy of rotation of islands of operation with corresponding rotation of areas of absolute non-interference of the birds has led to increased yield, especially in the penguin colonies. The other species which forsake the islands at the termination of their breeding demand initial freedom from molestation at and prior to the commencement of nest building. It is felt that with proper management such as the birds are now receiving, there need be little fear of failure of the annual guano crop.

Maize Production Costs.

Dr. J. C. Neethling, Senior Economist, Division of Economics and Markets.

THE Division of Economics and Markets has for several years been engaged on an agro-economic classification of the Union of South Africa, with the object of demarcating the country into uniform farming regions on the basis of natural physical phenomena. During the course of this survey certain economic data are also collected which serve as a basis for assessing the accuracy of the classification. These data are, however, not used for determining the efficacy of the farming systems in such regions, thorough successive studies being required for this.

Successive Studies.

The agro-economic regional classification of the Union being practically complete and the reports in that connection on the point of publication, the Division of Economics and Markets has decided now to launch out on the successive studies. The first of these is being devoted to the three Highveld areas, viz. the Transvaal Highveld, Caledon River and north-western Orange Free State. The choice fell on these areas for the following three reasons—

(1) they rank among the Union's most important cropping areas;

(2) maize plays an integral part in the farming system; and

(3) there are other industries in competition with the maize industry.

In the Transvaal Highveld maize faces competition from fresh milk; in the Caledon River area maize faces competition from wheat and factory milk and in the north-western Orange Free State, from wheat.

These successive studies are aimed at investigating the efficacy of the farming system in every region. To accomplish this, however, a detailed analysis of the most important branches of the industry is necessary to render possible a determination of the reasons underlying the success or failure of the farming concerns, i.e. whether the results are bound up with the practices in the principal industry. For this to be possible a careful calculation of the production costs is necessary. Incidentally it must be pointed out that the production costs determined in the course of this study are identical to those which would have been arrived at in a study confined solely to the computation of production costs as such.

Aim of Investigation.

The idea of this investigation is to visit the same regions for a successive and representative number of years, with the object of collecting data from the same farmers, in so far as this is possible. If for any reason farmers fall away others in the same locality and wherever possible, with farms of similar size, are approached. The investigation was commenced in September 1946 and consequently the Department already has data covering a period of two years at its disposal.

In view of the variability of the Union's rainfall and climatic conditions from year to year conclusions can be reliable only if based on data collected over a period of more than one year.

It is proposed to publish a comprehensive report on the details available after a period of 3 years, but in view of the immense value of the data so far analysed and the keen interest displayed in these figures by the public, it is considered desirable to publish at this stage the main

TABLE 1.—*Cash income from the various branches of the Industry in the Transvaal Highveld and the North-western Free State in 1945/46 and 1946/47.*

Branch of Industry.	Transvaal Highveld.						North-western Orange Free State.					
	1945–46.		1946–47.		Av. for 2 years.		1945–46.		1946–47.		Av. for 2 years.	
	Amount.	Percentage. of total.	Amount.	Percentage. of total.	Amount.	Percentage. of total.	Amount.	Percentage. of total.	Amount.	Percentage. of total.	Amount.	Percentage of total.
	£		£		£		£		£		£	
Maize	71,955·3	32·8	115,783·6	43·8	187,738·9	38·8	67,196·5	49·2	103,123·7	52·2	170,320·2	50·9
Wheat	863·4	0·4	—	—	863·4	0·2	22,264·7	16·3	30,137·7	15·2	54,402·4	15·7
Potatoes	14,192·5	6·5	10,880·9	4·1	25,073·4	5·2	—	—	128·6	0·1	128·6	0·04
Teff	6,874·0	3·1	4,632·5	1·8	11,506·5	2·4	81·0	0·1	570·0	0·3	651·0	0·2
Beans	18,759·4	8·6	12,254·9	4·6	31,014·3	6·4	—	—	—	—	—	—
Groundnuts	—	—	—	—	—	—	—	—	12,696·5	6·4	12,696·5	3·8
Other crops	15,730·1	7·2	16,410·1	6·2	32,140·2	6·7	3,629·0	2·6	2,378·1	1·2	6,007·1	1·8
TOTAL	128,374·7	58·6	159,962·0	60·5	288,336·7	59·7	93,171·2	68·2	149,034·6	75·4	242,205·8	72·4
Increase (Livestock)												
Dairy herd	6,758·5	3·1	4,820·8	1·9	11,579·3	2·4	1,835·5	1·3	2,358·2	1·2	4,193·7	1·2
Other cattle	16,988·8	7·8	15,847·5	6·0	32,836·3	6·8	11,653·1	8·5	7,337·3	3·7	18,990·4	5·7
Sheep	2,726·8	1·2	3,446·9	1·3	6,173·7	1·3	6,958·5	5·1	7,640·0	3·8	14,598·5	4·4
Other livestock	4,536·8	2·1	4,850·6	1·8	9,387·4	1·9	4,725·2	3·5	5,296·9	2·7	10,022·1	3·0
Livestock production.												
Fresh milk	40,438·4	18·4	48,365·3	18·3	88,803·7	18·4	1,524·0	1·1	1,805·8	0·9	3,329·8	1·0
Factory milk	1,319·9	0·6	2,300·0	0·9	3,619·9	0·7	20·0	0·01	170·8	0·1	190·8	0·1
Cream	3,767·8	1·7	5,485·6	2·1	9,253·4	1·9	3,402·6	2·5	4,073·2	2·1	7,475·8	2·2
Other dairy produce	1,691·9	0·8	1,990·0	0·8	3,681·9	0·8	503·1	0·4	813·2	0·4	1,316·3	0·4
Wool and Hides	5,199·0	2·4	7,851·5	3·0	13,050·5	2·7	5,837·1	4·3	8,074·0	4·1	13,911·1	4·2
Eggs	4,224·0	1·9	4,856·2	2·2	10,080·2	2·1	4,392·9	3·2	5,184·4	2·6	9,577·3	2·9
TOTAL LIVESTOCK	87,651·9	40·0	100,814·4	38·3	188,466·3	39·0	40,852·0	29·9	42,753·8	21·6	83,605·8	25·1
Other Income	3,092·5	1·4	3,328·7	1·2	6,421·2	1·3	2,567·3	1·9	5,931·9	3·0	8,499·2	2·5
TOTAL ALL SOURCES	219,119·1	100·0	264,105·3	100·0	483,224·4	100·0	136,590·5	100·0	197,720·3	100·0	334,310·8	100·0

results for the Highveld and north-western Orange Free State Areas, albeit in a very abridged form. These consist for the greater part of the details furnished to the Mealie Industry Control Board and the Marketing Board last March when the determination of maize prices for 1948-49 was under consideration.

The preliminary figures cover the 1945-46 production year (an exceptionally poor year for the Transvaal Highveld) and the 1946-47 production year when a relatively good maize crop was harvested. Although the figures merely cover a period of two years, it can already be noticed that the results in so far as the average are concerned will differ from year to year chiefly according to the difference in production per morgen. Unfortunately, the data for the Caledon River area are not yet ready for both years; consequently, the data for the Transvaal Highveld and the north-western Free State will be discussed first and the Caledon-river area dealt with separately later on.

Cash Income from the Farming Concerns.

To indicate the importance of the various branches of the industry, the total cash income from each branch, for the two areas, is given in table 1.

From this table it appears that both in the Transvaal Highveld and in the north-western Free State, maize constitutes the most important source of cash income. In the Highveld an average of 38·8 per cent. of the cash income for the two years, was derived from maize but even in the year when the maize crop was poor (1945-46) maize still furnished 32·8 per cent. of the cash income. In the north-western Free State maize production contributed an average of 50·9 per cent to the cash income for the two years.

Where fresh milk furnishes an average of 18·4 per cent. of the cash income in the Transvaal Highveld and therefore takes second place as source of cash income, wheat contributing 15·7 per cent. of the cash income is the industry second in importance in the north-western Orange Free State. In both areas the balance of the cash income is contributed by 14 other branches. To determine the efficiency of the farming systems in these two areas, a close analysis of two industries only, will suffice.

Costs of Maize Production.

Only the main aspects of the maize industry, especially those of basic importance in the discussion of the price of maize, are dealt with in this preliminary report. For the determination of the production costs of farm produce, the production of one or two farmers will not suffice, as the production costs differ not only from farm to farm in a particular year, but even from year to year on the same farm. Consequently, a large number of cases are taken over a number of years and the average production costs calculated accordingly. The figures published here are based on the data supplied by 100 Highveld farmers in 1945-46 and 102 farmers in 1946-47, while those for the north-western Free State are based on data supplied by 93 farmers in 1945-46 and 99 farmers in 1946-47.

Table 2 reflects the average production costs for two years in the areas mentioned.

To establish the average costs per morgen, the total costs for *all the farms* under each item are divided by the *total number of morgen;* and to establish the average costs per bag, the total costs for all farms are divided by the *total number of bags.* Thus, for example, the average costs for the Transvaal Highveld for the 1946-47 season were arrived at by dividing the total costs by 13,191 morgen and 148,092 bags of maize to establish the costs per morgen and the costs per bag, respectively.

Table 2.—Costs of production of Maize per morgen and per bag in the Transvaal Highveld and the North-western Free State for the 1945/46 and 1946/47 seasons.

Cost Items.	Transvaal Highveld.				North-western Free State.			
	1945–46 Season.		1946–47 Season.		1945–46 Season.		1946–47 Season.	
	Cost per morgen (sh.).	Cost per bag (sh.).	Cost per morgen. (sh.).	Cost per bag (sh.).	Cost per morgen (sh.).	Cost per bag (sh.).	Cost per morgen (sh.).	Cost per bag (sh.).
Labour—								
European	3·220	0·406	4·512	0·402	0·650	0·118	1·349	0·202
Non-European	25·386	3·202	27·368	2·438	12·264	2·236	14·353	2·145
Lorry	3·338	0·421	5·460	0·486	2·304	0·420	2·216	0·331
Tractor	10·205	1·287	14·041	1·251	12·266	2·237	14·566	2·178
Motor	3·760	0·474	6·349	0·566	4·216	0·769	4·345	0·649
Other power-driven machines	0·054	0·007	—	—	0·079	0·014	0·035	0·005
Implements	12·351	1·558	12·030	1·072	9·102	1·660	8·765	1·310
Draught stock (credits deducted)	18·561	2·341	14·987	1·335	9·151	1·668	7·533	1·125
Hire of tractor	—	—	0·288	0·026	—	—	0·022	0·003
Hail insurance	—	—	0·385	0·034	—	—	0	0
Housing	3·179	0·401	2·844	0·253	2·193	0·400	1·917	0·286
Seed	3·634	0·458	4·059	0·362	2·422	0·422	2·220	0·332
Bags and string	10·922	1·378	6·053	0·539	8·503	1·551	2·830	0·423
Fertiliser	11·315	1·427	12·361	1·101	6·863	1·252	5·700	0·852
Threshing costs	2·097	0·264	3·139	0·280	1·567	0·288	1·770	0·264
Hired transport	1·143	0·144	2·272	0·202	0·894	0·163	1·605	0·240
Incidental expenses and railage	1·798	0·227	3·125	0·286	1·838	0·335	2·285	0·341
Gross costs	110·963	13·995	119·363	10·632	74·321	13·553	71·511	10·686
Less credit for silage and stover	12·116	1·528	13·270	1·182	7·978	1·455	9·268	1·385
Nett cost (excluding rent)	98·847	12·467	106·093	9·450	66·343	12·098	62·243	9·301
Rent of ground at 5 per cent	12·531	1·580	12·413	1·106	10·279	1·874	10·475	1·565
Nett cost (plus interest)	111·378	14·047	118·506	10·556	76·622	13·972	72·718	10·866
Morgen planted to maize per farm	107·9		129·3		154·3		187·8	
Total maize yield per farm	855·2		1,451·9		845·9		1,257·1	
Maize yield per morgen	7·9		11·2		5·5		6·7	
Number of cases	100		102		93		99	

A full understanding of this point is important, otherwise a number of costs would appear to be too low. Take, for example, tractor costs. Here, the total costs were divided not only by the number of morgen, or number of bags from farms with tractors, but also by the total number of bags from all farming concerns covered by the investigation. Later on when analysis and comparisons are made of the farms with or without tractors, the figures will be calculated according to groups. This method leads to frequent enquires regarding threshing costs. From table 2 it appears that threshing costs in the Highveld come to 0·280 shillings, or less than 3½d. per bag. This does not mean, however, that the threshing machine was used at 3½d. per bag—the actual threshing costs were approximately 5d. per bag. Many farmers own threshing machines, however, and in such cases the threshing machine costs are included under implements and tractor costs and not under threshing costs. Then, again, there are farmers who do not thresh their entire maize crop. Supposing a farmer's crop is estimated at 1,000 bags, but of this he stores 100 bags in his feed stores to be put through the hammermills later on and threshes 900 bags only; he then pays for the threshing of 900 bags only, but his threshing costs are nevertheless divdied by 1,000 bags; the average costs are therefore reduced.

Another item which also appears smaller than the actual costs, is transport. A farmer delivers, say, 1,000 bags at the station. Of these, he delivers 500 with his own wagons or lorries, costs being included under implements or lorry expenses. The other 500 are, shall we say, transported by railway buses at 6d. per bag. The average cost under the heading of hired transport would be 2d. and not 6d. per bag, but a portion of the transport costs is included elsewhere.

Costs per Morgen and per Bag of Maize.

Returning to the figures in table 2, it will be noticed that the *gross costs per morgen* in the Transvaal Highveld was 110·963s. in 1945-46 as against 119·363s. in 1946-47. The *costs per bag* of maize were, however, 13·995s. and 10·632s. for the 1945-46 and 1946-47 seasons respectively. The *yield per morgen* immediately supplies an explanation for the difference. In 1945-46 the average yield was 7·9 *bags per morgen* in the Transvaal Highveld, while in 1946-47 the yield was 11·2 *bags per morgen.* In the north-western Orange Free State the *costs per morgen* were 74·321s. and 71·511s., respectively and the *costs per bag,* 13·553s. and 10·686s. for 1945-46 and 1946-47.

It is interesting to note that in both areas the credits for silage and stover offset the interest on ground. Consequently, there is only a minor difference between the gross costs, excluding interest, and the nett costs plus interest. During the year 1946-47 the production costs per bag, including interest on ground, was 10·556s. in the Transvaal Highveld and 10·866s. in the north-western Free State.

The question now arises as to why the costs per morgen are so much lower in the north-western Free State than in the Transvaal Highveld. The answer to this is that the cultivation costs are much higher in the Transvaal Highveld than in the north-western Free State, the lands being ploughed, harrowed and hoed more frequently in the former area than in the latter. A mere comparison of the number of labour days required per morgen of maize in the two areas will establish this fact.

For the sake of brevity the labour utilization per morgen of maize in 1946-47 in the two areas is taken. If the figures for Europeans and Non-Europeans are added together, we find that 9·14 days are required in the Transvaal Highveld for the cultivation of a morgen of maize i.e. from the stage when the first furrow is made until the maize is delivered. In the

TABLE 3.—*Labour on Maize, Transvaal Highveld and North-western Free State for 1945/46 and 1946/47 Crop years and the average for 1945/46.*

Work done.	TRANSVAAL HIGHVELD.								NORTH-WESTERN FREE STATE.							
	1945–46.				1946–47.				1945–46.				1946–47.			
	European (days).	Non-European (days).	Days per morgen. European (days).	Days per morgen. Non-European.	European (days).	Non-European (days).	Days per morgen. European (days).	Days per morgen. Non-European.	European (days).	Non-European (days).	Days per morgen. European (days).	Days per morgen. Non-European.	European (days).	Non-European (days).	Days per morgen. European (days).	Days per morgen. Non-European.
Prior to Harvesting.																
Ploughing	535	13,077	0·05	1·18	372	10,293	0·03	0·78	237	11,707	0·02	0·82	290	13,269	0·02	0·71
Harrowing	81	2,183	0·01	0·20	126	1,519	0·01	0·11	47	998	0·003	0·07	3	379	0·00	0·02
Disc-harrowing	159	2,077	0·01	0·19	237	1,939	0·02	0·15	23	1,195	0·002	0·08	34	789	0·00	0·04
Planting	346	6,146	0·03	0·55	690	5,790	0·05	0·44	160	5,347	0·01	0·37	334	5,583	0·02	0·30
Harrowing	223	5,441	0·02	0·49	386	4,202	0·03	0·32	115	2,753	0·008	0·19	55	2,919	0·00	0·16
Hoeing	516	14,503	0·05	1·30	1,167	15,616	0·09	1·18	150	7,573	0·01	0·53	364	9,703	0·02	0·52
Weeding by hand	125	24,230	0·01	2·18	255	23,686	0·02	1·80	181	18,348	0·01	1·28	230	20,202	0·01	1·09
TOTAL PRIOR TO HARVESTING	1,985	67,657	0·18	6·09	3,235	63,045	0·25	4·78	913	47,921	0·06	3·34	1,130	52,844	0·07	2·84
Harvesting and subsequent work.																
Harvesting and transport	436	32,357	0·04	2·91	1,378	45,486	0·10	3·45	87	26,349	0·006	1·84	710	34,777	0·04	1·87
Other	—	—	—	—	33	671	0·002	0·05	—	—	—	—	9	1,774	0·00	0·10
Threshing	70	4,031	0·006	0·36	122	4,829	0·009	0·36	6	1,390	0·000	0·10	840	2,219	0·00	0·12
Transport	42	1,066	0·004	0·10	269	1,567	0·02	0·12	14	1,173	0·001	0·08	172	2,070	0·01	0·11
TOTAL: HARVESTING AND SUBSEQUENT WORK	548	37,454	0·05	3·37	1,802	52,553	0·13	3·98	107	28,912	0·007	2·02	931	40,840	0·05	2·20
GRAND TOTAL	2,533	105,111	0·23	9·46	5,037	115,598	0·38	8·76	1,202	76,833	0·07	5·36	2,241	93,684	0·12	5·04
Casual workers prior to harvesting		1,534·7		0·14		1,053·7		0·08		390·1		0·02		404·6		0·02
During harvesting and after		1,648·4		0·15		2,430·1		0·18		1,651·1		0·12		2,807·7		0·20
TOTAL		3,183·1		0·29		3,483·8		0·26		2,041·2		0·14		3,212·3		0·22

north-western Free State it takes only 5·16 days; i.e. an average of four days less than in the other area.

It will be readily understood that it would take the Highveld farmer nearly twice as long to harvest his average of 11·2 bags per morgen, as it would the farmer of the north-western Free State to harvest an average of 6·7 bags per morgen. In point of fact the days required for harvesting, threshing and carting amount to 4·11 and 2·25 days per morgen for the Transvaal Highveld and the north-western Free State, respectively. This immediately gives a difference of 1·86 days per morgen at the expense of the Highveld.

There is also a difference in the cultivation prior to harvesting which places the costs in the Highveld on a higher level than those of the north-western Free State, since, apart from the fact that it takes nearly 4 days longer to cultivate a morgen of maize in the Transvaal Highveld, the average wages paid in this area are also a few pence higher per day with the result that in respect of labour costs alone, there is already a difference of ± 12s. in the total costs per morgen. With the more expensive cultivation, the costs of implements and draught oxen in the Transvaal Highveld are also higher. A comparison of the various items shown in table 2 will indicate the differences.

Attention must be drawn to the fact that only direct or calculable costs have been included in the above. Under European labour for instance, are included the wages paid to hired European labourers, costs of the farmer's sons working on the farm (even if they received no cash wages) and the costs of the farmer's own time spent on manual labour. The farmer's operators earnings is, however, not taken as a cost item nor is any allowance made here for the farmer's profit. That means that the nett production costs results shown in table 2 do not allow for these two important items. This fact must be borne in mind in the consideration of a reasonable price for maize to the producer. These items are not estimated here since they lend themselves to considerable differences of opinion. This article is confined to the cost items as established in the course of this study and about which there is not likely to be any considerable difference of opinion.

The fertiliser account given in table 2 includes the farmers actual expenditure on fertiliser as well as the calculation of expenditure on kraal manure or compost. The item which is at present forming so popular a topic of conversation in certain circles, viz. the maintenance of soil fertility, is not an admissable item to be included in the actual calculation of the costs of production. Unlike the gold mines agricultural soil is definitely not a waning asset, otherwise Europe and America would have been out of production by now. There can therefore be no question of including soil depreciation as an item in the calculation of production costs.

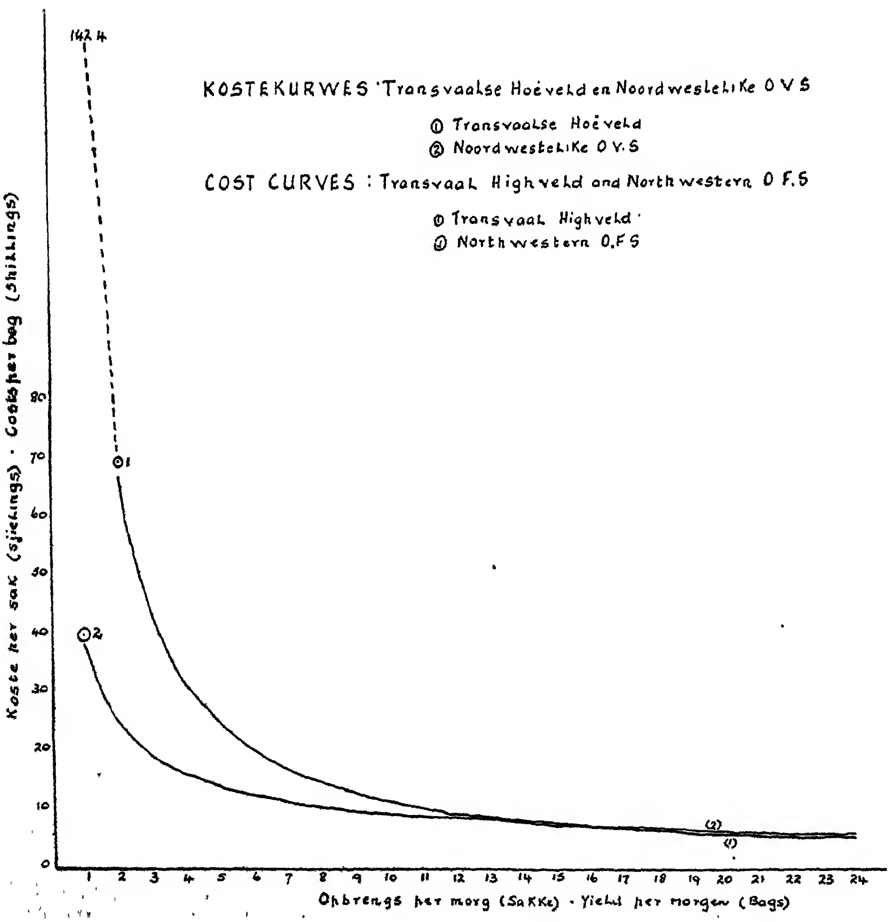
Basis of Costs of Production.

Which production costs should serve as the starting point in the determination of prices of maize: the average costs of production, or the highest or lowest costs? In reply to this question the distribution of the yields per morgen in the two areas for the two years covered by the investigation, are given in table 4 according to the groups.

As stated above the yield per morgen of maize is the most important underlying difference in production costs. When the average yield in the Transvaal Highveld was 7·9 bags, the costs were 14s. per bag, and when it was 11·2 bags per morgen, the costs were approximately 10s. 6d. per bag. If then 11·2 bags per morgen were taken as basis, the costs to all farmers reaping less than 11·2 bags, would exceed 10s. 6d. In this

TABLE 4.—*Distribution of the Yield per Morgen, Expressed as Percentages of Farms, and of the Production in the Transvaal Higveld and the North-Western Free State. Figures Based on the Data Furnished for the 1945-46 and 1946-47 Seasons.*

TRANSVAAL HIGHVELD.			NORTH-WESTERN FREE STATE.		
Yield per morgen.	Percentage of farms.	Percentage of crop.	Yield per morgen.	Percentage of farms.	Percentage of crop.
7 bags or less....	18·4	8·4	3·5 bags or less	22·9	10·3
7·1– 9 bags......	15·5	12·6	3·6– 5·0 bags..	17·7	13·6
9·1–11 bags.....	19·4	13·6	5·1– 6·5 bags..	17·7	17·5
11·1–13 bags.....	11·6	16·5	6·6– 8·0 bags..	16·7	17·1
13·1–15 bags.....	10·7	12·7	8·1– 9·5 bags..	7·8	9·2
15·1–19 bags.....	16·5	21·4	9·6–11·0 bags..	5·2	8·2
19·1 bags and over	7·9	14·3	11·1 and over...	12·0	24·1
TOTAL........	100·0	100·0	TOTAL........	100·0	100·0



particular case it would have affected 53·3 per cent. of the farmers and 34·6 per cent. of the crop in the Transvaal Highveld. These farmers would therefore have had to content themselves with a smaller profit than farmers producing at the average cost. This instance is merely cited here as an example of what should be taken into consideration in deliberations on a price for maize. There are, of course, also other factors, e.g. the prices of agricultural products, etc. but it is not proposed to devote any attention to these aspects here.

Yield per Morgen and the Costs per Bag.

The rôle played by yield per morgen in the determination of the costs per bag, is clearly revealed in the following figure viz. a logarithmic or mathematically calculated graph showing the relationship between production costs per bag and yield per morgen. This graph is based on the 202 cases taken from the Transvaal Highveld, and the 192 from the north-western Free State for the two years covered by the investigation.

From this graph it can be seen firstly, that down to the 16 bags per morgen level, the cost level in the north-western Free State is lower than that of the Transvaal Highveld: from there onwards the cost level of the latter drops slightly. This means that at 16 bags per morgen the farmer of the north-western Free State must spend more than the farmer of the Highveld of the Transvaal to obtain an increased yield per morgen. Secondly, that initially the *costs per bag* decrease rapidly for every increase in yield per morgen, but subsequently show hardly any decrease with an increase in yield per morgen. If we take the Transvaal Highveld as an example, it will be seen that the costs decrease by 19s. i.e. from ± 43s. to ± 24s. per bag, with an increase in yield of from 3 to 5 bags per morgen. With an increase of from 5 to 8 bags, the costs decrease by 9s. or from ± 24s. to ± 15s. per bag. Between 15 and 18 bags per morgen, the decrease is less than 1s. 9d. per bag.

With this graphic representation of the cost, an approximate determination of prices can be made. Once the other factors such as operator's earning, demand and supply, overseas markets, etc. have been determined and the profit to be allowed to the producer for covering these items has been decided upon, the costs per bag can be determined on the basis of an accepted or agreed yield per morgen. Then, and then only, can the costs of production be included in the determination of the price. This means then the costs per bag on the basis of an accepted yield per morgen plus the profit agreed upon.

New Bulletins.

Bulletin No. 284.—*The Feeding of Farm Animals (Dairy Cattle)*, by J. C. Bonsma, Division of Agricultural Education and Research, is obtainable from the Editor of Publications, Department of Agriculture, Pretoria. Price 3d., prepaid.

Bulletin No. 229.—*Soft-Cheese and Cottage Cheese* (Second and Revised Edition), by G. D. le Roux, Division of Dairying, is obtainable from the Editor of Publications, Department of Agriculture, Pretoria. Price 3d., prepaid.

Bulletin No. 286.—*The Litchi in South Africa* by Dr. R. H. Marloth, Division of Horticulture, is obtainable from the Editor of Publications, Department of Agriculture, Pretoria. Price 6d., prepaid.

Blowfly Strike in Sheep.

Application of the New Insecticides.

R. du Toit, and P. G. Goosen, Research Officers, and
J. M. de Kock, Technical Officer, Onderstepoort.

THE infestation of the skin of sheep with blowfly larvae, is undoubtedly one of the greatest problems with which wool farmers in all parts of the world have to contend.

The Older Methods of Control.

This problem has been the subject of much investigation, and there is a formidable list of publications dealing with the numerous ways in which the problem may be tackled. Initially efforts at control were chiefly directed at the destruction of the blowflies themselves by the removal of the carcases in which they bred. Bait-traps were extensively used to catch not only the adult flies but also the larvae. When it was discovered that the green blowfly, *Lucilia cuprina*, was responsible for more than 90 per cent. of all primary attacks on sheep, and that the fly was adapted to breed almost exclusively on sheep without making use of carcases, the destruction of all maggots on sheep by treatment with a 100 per cent. effective insecticide was recommended. The Government blowfly spray was developed, and it was hoped that its widespread use would bring in its wake a high measure of destruction of the green blowfly.

The experience gained from the application of the above-mentioned measures over a number of years is most disappointing, and it must be admitted that actually no diminution in the incidence of blowfly strike worth mentioning has followed on the efforts to destroy the flies.

Attention was also given to protection of sheep against blowfly infestation. Various methods were applied, all of which contributed in a greater or lesser degree towards promoting the efforts at control. These methods include spraying of sheep in the crutch and round the base of the tail with arsenic solutions, under high pressure (so-called jetting), crutching or removing the wool in the crutch, and round the base of the tail, which is readily soiled, and removal of skin folds (Mule's operation).

The breeding of sheep less susceptible to blowfly strike by the elimination of skin folds has been recommended by some, but this requires a long-term breeding policy. Other methods have also been applied, but with less success, as for example, rugging of the back and hindquarters of the sheep; not docking the lamb's tails thus enabling the sheep to ward off the flies. Repellents have also been investigated on a large scale, but up to the present no repellent has been found to be effective for a sufficiently long period.

Beneficial Aspects of Blowflies.

As a result of all the work done in the different countries where blowflies constitute a problem, a very thorough knowledge of the mode of life and habits of the fly has been acquired. Although blowflies are regarded as a serious pest, chiefly on account of the menace they constitute to wool farming, they nevertheless serve a useful purpose, and it can even be said that their total eradication would be disadvantageous to mankind. Their enormous reproductive capacity, coupled with their

habits of feeding on carrion, make them the most effective known destroyers of carrion. Furthermore, blowflies play a very important rôle in the pollination of a large number of plants, being almost as valuable in this respect as the honey-bee. Thus, if sheep could be effectively protected against blowfly strike, the blowflies would virtually constitute no problem, and their useful qualities would be preserved for humanity.

New Synthetic Insecticides.

The discovery during the war years of the insecticidal properties of the new synthetic insecticides of which D.D.T. and B.H.C. (Benzene-hexachloride or "666") are probably the best known in the Union, has opened up a new field of investigation into the blowfly problem.

A Sheep being treated with an Insecticide.

It has been found that although D.D.T. and B.H.C. are not effective in destroying full-grown larvae, they do destroy the larvae immediately after hatching, i.e. larvae in the first stage.

One of the known useful properties of D.D.T. first to be examined was its durability. Tests were carried out by spraying sheep with different dilutions of D.D.T. in such a way as to penetrate the wool right down to the skin, and then to expose the treated animals to natural as well as artificial blowfly strike. The D.D.T. provided a high degree of protection and its application as a preventative against blowfly strike in sheep is practical under veld conditions.

The other known synthetic insecticides were subsequently tested. Far better results than had been expected were obtained with B.H.C. which gave sheep immunity for a considerably longer period than D.D.T. Recently other synthetic insecticides, discovered by research workers

overseas, have been tested and the results with *Chlordane* or the so-called *Velsicol* 1068 have been particularly promising. It appears therefore that there is unlimited scope for research into the protective properties of the ever-increasing list of synthetic insecticides against blowfly strike in sheep. The guiding principle is to retain a high concentration of the insecticide in the wool for as long as possible especially in those parts of the body usually attacked.

In the largest portions of the sheep areas of the Union where the rainfall is low, by far the most generally attacked parts of the body are the crutch and the breech, due to the soiling of wool in these parts with urine in the case of ewes and faeces in the case of all sheep, especially when the animals purge. For this reason and for the economic application of the insecticides it has been recommended that only those parts of the animals should be treated, but naturally any part of the body may be sprayed, e.g. round the sheath of hamels and rams, round the horns of rams where injuries resulting from fights are liable to blowfly strike. In wet climates the shoulders of sheep are frequently attacked and should be treated.

Owing to the fact that the insecticides tested up to the present are insoluble in water, investigations have been directed at finding the most suitable formulae for application on sheep. Solutions of the insecticides in organic solvents have been found to be injurious owing to skin irritation, while emulsions give good results. The latest investigations, however, point to insecticides in the form of wettable powders as being most satisfactory; in this form there is less danger of injury to the skin and the effect is considerably more lasting, probably due to the fact that the relatively large particles of the insecticides are covered with wool grease, which affords them a measure of protection against weathering.

Methods of Application.

It is customary in the Union to dip sheep once annually usually after shearing, for the control of ticks, lice and keds. Both D.D.T. and B.H.C. are known to be very effective against the parasites, and the dipping method was applied with these insecticides to establish the practicability of dipping the sheep in dip-washes strong enough to ensure a satisfactory measure of protection. The results were wholly unsatisfactory and tests were then conducted under both laboratory and veld conditions, to establish the most effective concentrations as well as the best methods of application.

Benzene hexachloride (B.H.C.) in the form of a wettable powder and diluted with water to form a white suspension gave the best results. The strength decided upon was 0·5 per cent. of the gamma isomer or active ingredient. A wettable powder of B.H.C. containing 40 per cent. of the technical product is available and 10 lb. of this in 7 gallons of water gives the correct strength.

In applying the insecticides, it is recommended that the sheep be held in a sitting position with its rump on a sheet of corrugated iron. The insecticide is then thoroughly sprayed with a high pressure spraying pump (e.g. a locust spray provided with a nozzle of the Vermorrel or Febre type) into the wool between the legs, and round the anus and the sheaths in the case of hamels and rams. It should be seen to that the wool is saturated to the skin and to effect this it is desirable to open the wool with the fingers during the process of spraying. The liquid which runs off is absorbed by the wool on the rump, so that the parts usually attacked are thoroughly treated in this way. The method of treatment is shown in the accompanying illustration.

[*Continued on page* 390.

Plant Diseases and Cultural Operations.

Dr. F. C. Loest, Plant Pathologist, Subtropical Horticultural Research Station, Nelspruit.

IN a previous article in this journal (May 1948) it was stated that incorrect cultural practices were often the basic cause of a wide range of plant diseases in many of our horticultural and field crops. Some of the cultural mistakes and the diseases caused by or arising therefrom were given in that article, and the subject is being continued in the present article.

Irrigation and Fertilization.

The main conditions contributing to the incidence of "Dry Root Rot" and "Diplodia Gummosis" in citrus, caused by *Diplodia natalensis* Pole Evans; root rot in avocados, caused by *Phytophthora cinnamomi,* and "Foot Rot" in papaws, caused by Pythium spp., are an impaired aeration of soils which is brought about by an excess of water, especially in soils with faulty physical conditions, and the influence which excess water has on the level of available nitrogen in the soil.

Influence of Aeration in General.

With the possible exception of rice, not a single cultivated crop prefers a badly aerated soil to a reasonably well aerated one. *Many parasitic soil organisms have a lower oxygen requirement than the roots of the higher plants, and can grow well in watery solutions which would injure or kill such roots.*

When a soil is irrigated, water and hence plant nutrients become available to the plant, and the air and gases in the soil are excluded from the root zone. As the water in the soil is used up, air again fills the spaces formerly occupied by the water. Good aeration of soils will therefore follow wide fluctuations in the soil moisture.

Influence of certain Soil Factors.—Arising out of the foregoing, the factors to be analysed are—

(1) faulty physical condition of the soil; (2) excessive supply of water; and (3) the nitrogen-level in the soil.

The influence of *factors* 1 *and* 2 on the aeration can be discussed under the following headings:—

1. (*a*) *Hardpan.*—The cultivation of soil before it is sufficiently dry, breaks down its structure in a zone a few inches below the level of cultivation. This results in the formation of a hardpan, plough sole or cultivation sole, which may be so compact and impervious as to impair the penetration of water and air to the soil below. Roots also have great difficulty in penetrating this layer.

(*b*) *Impervious Sub-soil.*—Citrus and avocado trees have been found infected with severe root rot on very light sandy soils on top of impervious "ou klip". Water cannot drain away, the water table rises, and the roots become asphyxiated.

2. (*a*) *Over-Irrigation.*—The most important single practice which contributes to the development of root rot is over-irrigation. Using more water than is necessary is not only a waste of water, but it also causes loss of fertility by the leaching of soluble plant nutrients, chiefly nitrates.

The golden rule to follow is not to irrigate a wet soil. Where a soil tube or soil augar is not available, the ordinary spade may be used

to great advantage. Digging down to a depth of 18 inches or more at a few random spots throughout a land will determine whether the soil is sufficiently dry to need irrigation. Especially with citrus and avocado trees, the degree of wilting of the foliage is not a safe guide. Where a certain percentage of the root system, especially the fibrous roots, has succumbed to root rot, the trees may show a varying degree of wilt in soil which is still sufficiently supplied with moisture; in such cases there is no need for irrigation.

(*b*) *Uncontrolled Irrigation.*—In orchards where the furrow system of irrigation is practised and where the run is too long, trees at the head of the furrows are usually in a poor state of health and unproductive. If trees at the end of the run receive sufficient water, then those nearer the head of the furrow will already be over-irrigated. On the other hand, if trees at the head of such furrows receive the proper amount of water, those at the end will be under-irrigated. For citrus it is suggested that the length of the furrows should not exceed 200 to 300 feet on light soils and 400 feet on heavy soils. It should of course be realized that the length of run chosen should be guided by the gradient of the furrows.

(*c*) *System of Irrigation.*—As the lateral movement of water is slight, the furrow system of irrigation practised in commercial orchards does not wet the whole of the root zone. The ill effects of over-irrigation with the furrow system are therefore not so pronounced as those with the basin system of irrigation. However, by exercising care not to irrigate a wet soil, the basin system, which is superior in other respects, can be made safe.

In some parts of the eastern Cape Province and Natal "Brown Rot Gummosis" *Phytophthora citrophthora,* (Sm and Sm) Leon, has at times caused severe losses. Of the conditions contributing to the incidence of this disease, none is so important as wet soil in direct contact with the base of the trunk for a lengthy period. This commonly follows when soil is irrigated up to the trunk of the trees. By making proper basins in the tree row, so as to extent well beneath the drip of the tree on either side, and by never irrigating the remaining small inner area around the trunk, this disease is very largely prevented.

To prevent irrigation water from reaching the trunks, circular basins 2 to 3 feet in diameter are often constructed around them. Unless a suitable opening is left in this basin to prevent water collecting therein during periods of continued rain, this practice may increase rather than reduce the chances of "Brown Rot Gummosis" setting in on the trunk of the tree.

(*d*) *Seepage of Water.*—Constant seepage of water, either from main furrows bordering orchards or from springs or reservoirs, is not an uncommon contributing factor to the incidence of root decay, especially in avocado, papaw and citrus orchards. Root asphyxiation is accentuated when the soil in such orchards is of a heavy type, though even on light soils severe asphyxiation of roots takes place if the sub-soil is impervious.

(*e*) *Inter-Cropping.*—A fairly common cultural practice causing root rot is inter-cropping. As the expenditure in the establishment of avocado and citrus orchards, for instance, is rather high, in that the first remunerative crop is only obtained in the 4th and 5th year, respectively, from the date of planting, growers usually plant catch or inter-crops between the rows. The profit on such crops, it is argued, reduces the overhead expenditure. Often this step is taken on account of limited available land under irrigation. In order to give an optimum supply of water to the inter-crops, chiefly vegetables such as tomatoes, beans, cabbage, etc., irrigation is needed about once weekly. The result is that the tree roots are over-irrigated and develop root rot in the course of a few years.

It is only during the first two years of the life of the trees that the harmful effects of inter-cropping may be escaped, because then most of the roots of the trees have not yet reached the inter-cropped area.

3. *Soil Nitrogen Level.*—A deficiency of nitrogen is more common than a deficiency of any other essential nutrient. Furthermore, no other nutrient is more important for maintaining the health and the vigour of plants than nitrogen. The high solubility of this element in the nitrate form causes it to be very easily leached beyond the root zone and hence to be no longer available to the plant. Therefore great care should be taken to avoid the supply of an excess of water to the soil, and this, coupled with proper basining in orchards and contouring of land, will result in the maximum benefit being obtained from the nitrogen applied.

A more striking example of the very close relationship existing between vegetative vigour and degree of parasitism can hardly be found than in the case of the "Diplodia Gummosis" disease of lemons. When the low nitrogen level in the soil is the result of leaching or insufficient nitrogen application, lemon trees may become heavily attacked by this disease. Unless the disease has been allowed to progress too far before applying control measures, not a single instance is known where diseased lemon trees have not fully recovered within a relatively short period after having been fed with sufficient nitrogen. Similarly, "Dry Root Rot" of citrus has often been very effectively controlled in the early stages, merely by avoiding the further excessive supply of water to the soil, and by feeding the trees with nitrogen. Equally effective control of root rot in avocados during the early stages of the disease has also followed on a judicious irrigation and fertilizer practice.

A heavy incidence of root rot in citrus and avocado trees has been noted to follow continual and exceptionally heavy rains, but usually only after an interval of many months. Consequently, the part played by prolonged and heavy rains is often overlooked. When the programme of a fertilizer application in such orchards was studied, it was found that the fertilizer and/or manure was applied prior to the rains, and it was argued that the trees have been well fertilized and that no further additions of fertilizer were deemed necessary, in spite of the leaching of nitrogen by the heavy rains. And yet there was sufficient proof that the root decay is very closely connected with a low level of nitrogen in the soil over a lengthy period, because a marked recovery of such trees has repeatedly been obtained when sufficient nitrogen has been supplied.

As there is a tendency for the lemon to bear fruit continually and for grapefruit, especially the Triumph variety, and the naartjie to overbear annually, it is necessary to maintain the vegetative vigour of these trees if they are to be guarded against attacks of root and trunk diseases.

The yellowing of leaves due to a deficient nitrogen supply in the soil, which is such a common symptom in citrus, is not met with in the avocado, and in the absence of this warning symptom, avocado growers can only place reliance on a regular annual application of fertilizers.

Conclusion.

From the few examples given above, it should be clear that there exists a very close relationship between the vegetative vigour of plants and the degree of parasitism of the organism (organisms) endangering the well-being of such plants, and that the interdependence and inter-relationship of plants, soil, disease, and climate should be apparent. With comparatively few exceptions, the presence of diseases in our cultivated crops should be a warning to us that our cultural methods may not be altogether correct, and therefore constitute the basic cause of such diseases.

The Black Spot Disease of Citrus.

Dr. Vincent, A. Wager, Officer in Charge, Botanical Station, Durban.

THE Black Spot disease of citrus* has been known in the mist-belt area of Natal since 1929. It was thought that the fungus required damp conditions for its development, for the disease is known only from two other places in the world, Australia and Japan, in areas of similar high humidity.

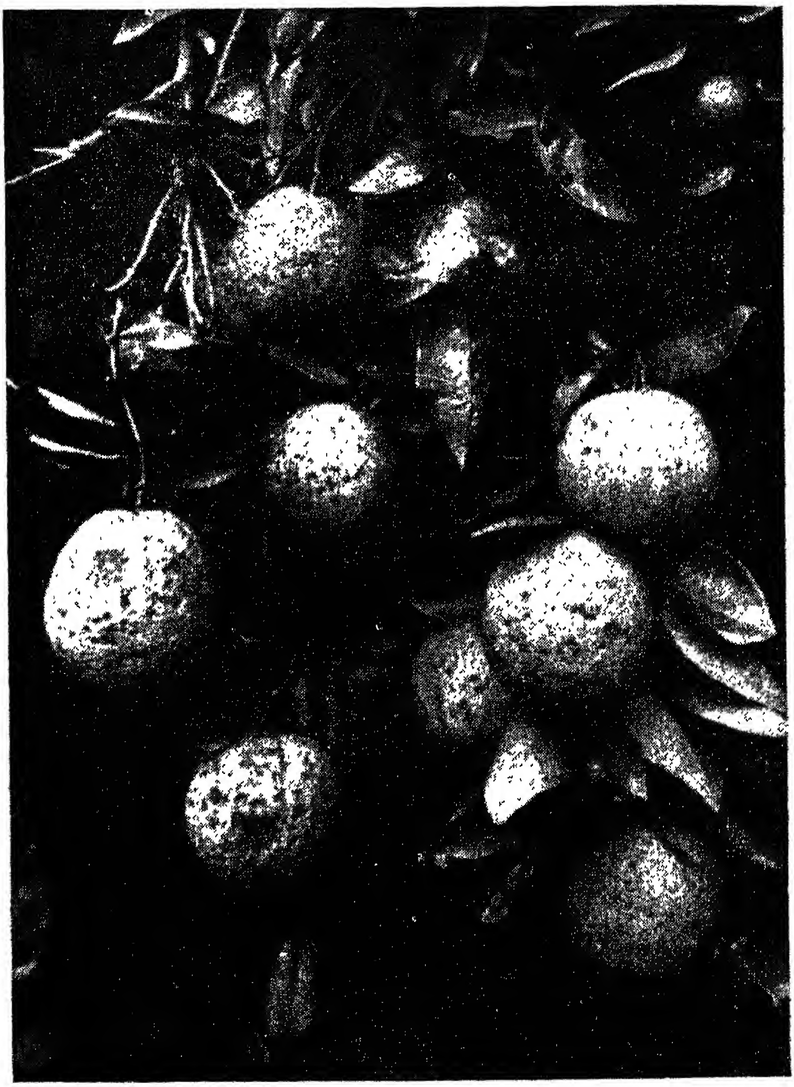


FIG. 1.—Most of the oranges on this tree were severely infected with Black Spot.

[Photo : V. A. Wager.

* Caused by the fungus *Phoma Citricarpa* McAlp.

In 1942 Black Spot appeared for the first time at Verulam on the Natal coast on lemons. By 1944 is had spread to neighbouring Valencia trees and was also reported from the dry Umkomaas Valley in Natal.

In 1945 it was occurring on most citrus plantings on the whole Natal Coast, and an extremely serious outbreak was reported on six farms at Tzaneen in the Northern Transvaal.

By 1946 twelve additional farms in the Tzaneen, Politsi, Duivelskloof and Letaba areas of the Northern Transvaal were seriously infected. At the same time the disease was reported from one farm near Nelspruit and from four near Barberton in the Eastern Transvaal, from one farm near Rustenburg in the Western Transvaal, and from Muden in Natal.

During the past year the disease had spread to many neighbouring orchards in the Eastern and Northern Transvaal.

As conditions in these infected localitites are quite unlike the mist-belt of Natal, being hot and dry, there seems no reason why the disease should not spread to all parts of South Africa.

The Black Spots affect only the rind of the fruit, making it unsightly and lowering its market value. Infected fruits go mouldy quickly, and moreover do not hang on the tree, but drop off.

Effect of Temperature.

The spores of the funges enter the fruits only when they are small, that is, from the time the petals fall off until the fruit is about two inches in diameter. No spots develop until the fruits begin to mature and start colouring when the weather warms up. It will be remembered that the disease appears first on the sunny or warm side of the tree.

The effect of temperature was simply demonstrated. Fruits showing not one spot were picked off the shady side of an infected tree and divided into two lots, one lot being left on the laboratory table where the temperature remained around 60° F. and the other lot was placed in an incubator running at 80° F. At the latter temperature spots began to appear at the end of four days and after two weeks the fruits were severely spotted. No spots developed on the cooler fruits even after three weeks.

The experiments was repeated using grass-green fruits the size of a golf ball, and larger fruits just beginning to show colour. In each case spots appeared only at the higher temperature.

A further experiment proved that temperatures comparable to cool nights (around 60° F.) and hot days (80, 90 or 100° F.) also induced the rapid appearance of spots.

The Shipment and Cold Storage of Infected Fruit.

Badly spotted fruits, averaging 25 spots each, were divided into three piles and placed in incubators running at 40° F., 70° F. and 85° F. At the end of the first week an average of 2 new spots per fruit had appeared at 40° F., 11 at 70° F. and 21 at 85° F. During the second week another 2 new spots (average) per fruit appeared at 40° F., 5 more at 70° F. and 4 more at 85° F. This experiment showed that if infected fruit can be placed in cold storage, very little further development of new spots takes place, but considerable new spots show up at 70° F., and more at 85° F. such as in fruit left standing in the sun, in an iron-roofed packshed, or in railway trucks.

This last fact was amply demonstrated at Tzaneen in 1946. Early in September a long spell of mid-summer temperatures was experienced. As a result, one of the worst infections of Black Spot ever seen occurred. As no spotted fruits were allowed for export it meant that all fruits going

over the grading tables had to be turned over and examined individually, taking so much time that the packhouse output was reduced to about one third.

Cases of fruit showing no spots were then despatched to Cape Town for export. The hot weather continued and when the fruit reached the docks and was examined nine days later, it was found that up to 25 per cent. showed infection, and the consignment was rejected. The fruit was returned to Tzaneen and by this time the infections had become large unsightly dark blotches, as shown in the illustration. This shows that unless cold-storage facilities are immediately available, it is inadvisable to attempt to export fruit from an orchard showing infection.

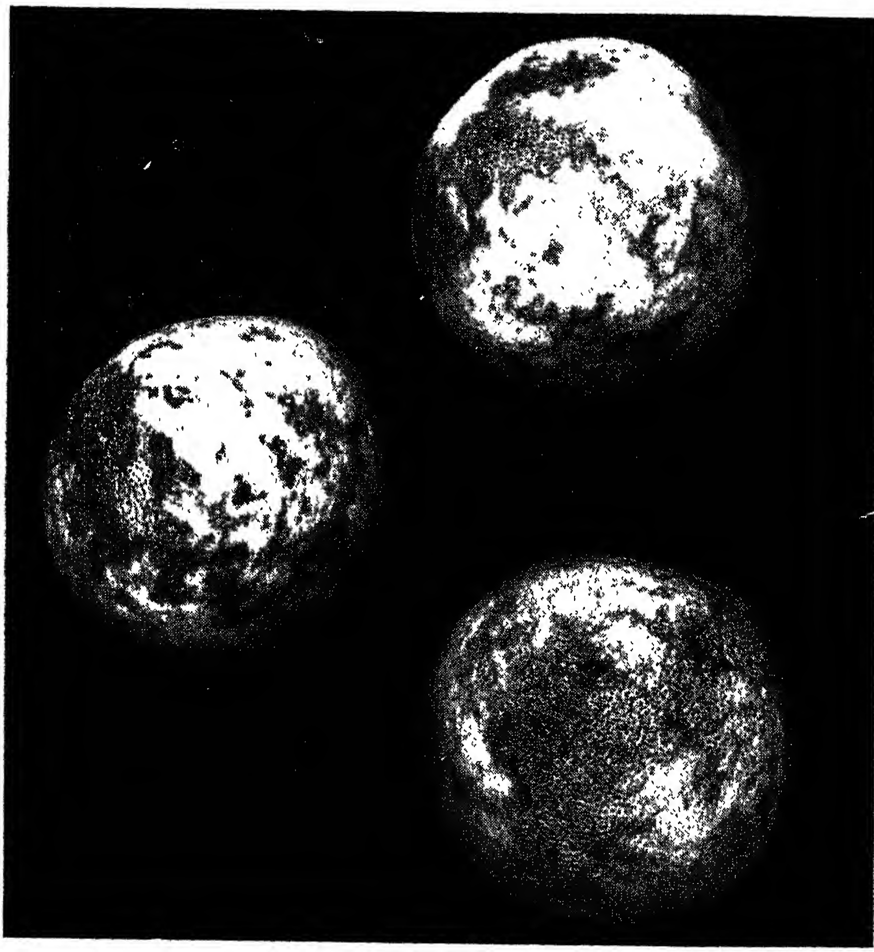


FIG. 2.—These oranges showed no Black Spot when they were packed and sent to Cape Town for export, but were severely infected some ten days later.

[*Photo* : *H. King*.

Varieties Affected.

Smooth lemons appear to be most susceptible to infection. Other varieties affected are rough lemons, grapefruit, mandarins and Valencias. Owing to the fact that Navels mature during the cold winter months, they are not affected unless they are allowed to hang until the weather warms up.

Curiously enough, lemons can show infection at any stage from the time the fruits are two inches in size.

In the cooler areas, like the Natal mist-belt, the disease appears *after* the fruit is internally mature (i.e. passes the government tests). If picked as soon as possible, then hardly any fruit would be infected, but it has been the custom to let it hang until November to January to catch the high prices, and thus heavy losses occur.

On the coast, spots begin to appear in May on Valencias when showing slight colour and long before they are mature. In the Barberton area this year the disease appeared as early as the end of April. In the Tzaneen area it appears towards the end of August, but in all cases *before* the fruit can pass the Government teats for maturity.

Suggested Control Measures.

(1) Pick fruit from infected orchards as soon as possible.

(2) Pick the sunny side of the tree first.

(3) Induce early-maturing of fruit on infected orchards by spraying

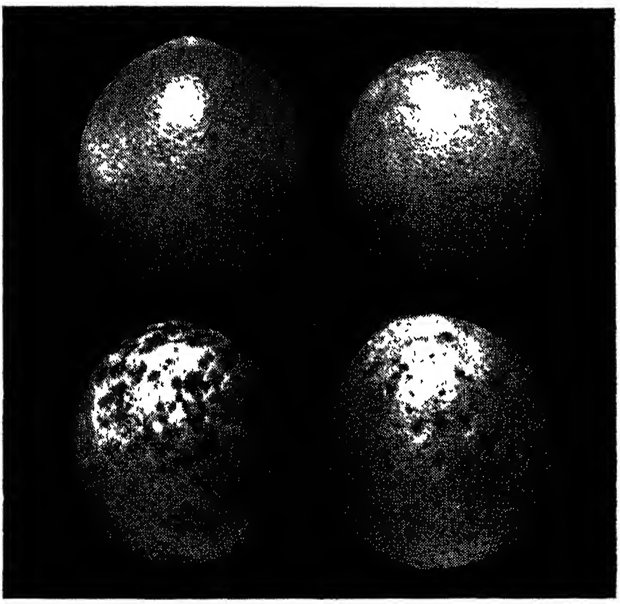


FIG. 3.—Clean fruits developed Black Spot (below) after two weeks in an incubator at 85° F., whereas none developed at 60° F. (above).

[*Photo* : *V. A. Wager.*

with lead arsenate (1 lb. in 100 gallons water), every third year. Some farmers in the Tzaneen area have done this successfully, getting their fruit away some six weeks earlier, and before any spot appeared at all. If the disease occurs early, however, as it does at Verulam and Barberton, this method would not work.

(4) Hand-sorting to exclude all spotted fruit takes too long, and enough spots are likely to appear in transit to cause rejection at the port. It is therefore advisable not to export fruit from orchards where the disease has already appeared that season, unless it can be delivered to the nearest port and into cold storage with very little delay.

(5) *Spraying.*—Experiments are being carried out to find a satisfactory means of preventing the disease by spraying. At the present moment the following sprays are suggested: Bordeaux mixture 2:1:80, and

Copperoxychloride (50 per cent.) 1 lb. in 80 gallons. Proprietary sprays are also being tested out by the Division of Botany and Plant Pathology.

The spray should be applied preferably with 200 to 300 lb. pressure, at (*a*) $\frac{2}{3}$ petal drop (*b*) six weeks later and (*c*) six weeks later. In spite of spraying, a number of fruits might still become spotted owing to the fact that in a season of uneven flowering some fruits may be quite large before spraying, and some blossoms may open just after spraying and the fruits would therefore have six weeks to become infected before the second spraying. Heavy rains may also wash the spray off.

It has been found in Australia that better control in obtained if a special type of white oil is added at the rate of $\frac{1}{2}$ gallon in 80 gallons at each spraying.

When oil is normally used for controlling scale, then it is added to the third spraying at the rate of 1 gallon in 40 gallons.

At present no information is available in South Africa on the effect of fumigation on sprayed trees. In New South Wales, however, it is considered safe to fumigate after at least $5\frac{1}{2}$ inches of rain have fallen after the last copper spraying. Experiments are being carried out to test this point.

In the mist-belt of Natal a fungus parasite keeps the scale in check. Spraying kills this parasite, so the scale multiplies rapidly unless oil is added.

(6) When making new plantings it is advisable not to obtain young trees from any nursery in an infected area.

Preparation of Bordeaux Mixture.

Bordeaux mixture is easy to prepare. The formula 2:1:80 means 2 lb. of copper sulphate, 1 lb. of hydrated lime and 80 gallons of water. The copper sulphate is obtainable as a finely ground powder called "Snow" (about $6\frac{1}{2}$d. per lb.). It is placed in the wire screen tray at the top of the spray tank and is washed in with the water as the tank is filling. When the "Snow" is all gone and the tank is three parts full the high-grade finely-ground hydrated lime (about $1\frac{1}{2}$d. per lb.) is put in the screen tray and also washed in, with the agitator going all the while. Finally the oil is added.

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Blowfly Strike in Sheep:—

[*Continued from page* 382.

Long-wooled sheep require a considerable quantity of liquid to wet them thoroughly. Crutching is therefore desirable for the more economic application of the method and even for better protection, since there is less likelihood of the wool being soiled.

It must be emphasized here that the recommendations made in this article, with regard to the use of B.H.C. are only tentative, as already there are indications that other insecticides, not yet procurable in the Union, may possibly furnish an even higher measure of protection.

Further Laboratory Studies with New Organic Insecticides.

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IN a previous article (2) the results of laboratory experiments with some of the newer organic insecticides against Elegant grasshoppers, ground weevils, C.M.R., Astylus and fruit-eating beetles, and red spider were presented. Further work with other insect pests has now been completed and the present article may be regarded as a sequel to the first one.

Insecticides.

The insecticides tested were:—

(1) Benzene hexachloride (B.H.C.);
(2) Dichloro-diphenyl-trichloroethane (D.D.T.);
(3) Chlordane, a chlorinated hydrocarbon insecticide with an empirical formula $C_{10}H_6Cl_8$;
(4) Thiophos 3422 (diethyl-p-nitrophenyl thiophosphate) and
(5) Toxaphene, a chlorinated camphene insecticide.

Natural cryolite, lead arsenate and nicotine were included in certain of the experiments to serve as a basis for comparison for the newer insecticides listed above.

Methods.

1. The chemicals were applied as dusts throughout all the tests.
2. Dusting was done with an apparatus described in a Science Bulletin.(3)
3. Both prior and subsequent to the application of the insecticides the insects were kept under constant temperature and humidity conditions (75° F. and 70 per cent. R.H.).
4. The mortality figures presented in the tables have been corrected for normal mortality by means of Abbots' formula.(1)

(I). The Wattle Bagworm.

The wattle bagworm (*Acanthopsyche junodi*, Heyl), is a native insect which lives normally upon indigenous thorn trees, but soon took to the black wattle (*Acacia molissima*) and to a lesser extent to the green wattle (*Acacia decurrens*) when they were cultivated on an extensive scale, where it has increased to an alarming extent and become a pest of great economic importance. The leaves of the wattles are eaten, and in cases where the bagworms are numerous, the whole tree may be completely defoliated thus causing a severe set-back to growth and bark increment.

The insecticides tested were 5 per cent. benzene hexachloride, 5 per cent. Toxaphene, 5 per cent. chlordane and natural cryolite applied at the rate of 0·05 mg., 0·07 mg., 0·09 mg. and 0·11 mg. per sq. cm. which is the equivalent of 5, 7, 9 and 10 lb. per acre, respectively. D.D.T. was not used in these experiments as it had previously been shown to be inferior to natural cryolite—the insecticide at present used for the control of this pest.(4)

The larvae were isolated in glass specimen tubes, plugged with cotton wool, and were fed for 24 hours on small pieces of wattle foliage which were dusted with the chemicals under investigation. Thereafter they were transferred to clean tubes containing fresh, untreated leaves; the mortality records were made at 24-hourly intervals.

In certain of the experiments both the caterpillars and the foliage were dusted, while in others only the leaves were treated. 40 bagworms were fed on each compound in each experiment.

Results.

The results obtained with the different insecticides are given in Table 1.

Conclusions.

(1) Benzene hexachloride, Toxaphene and chlordane were markedly more effective than natural cryolite against first and second instar bagworms when applied to the leaves only or when both leaves and worms were dusted.

(2) Benzene hexachloride appeared to be slightly more effective than Toxaphene and chlordane against the first two instars.

(3) The superiority of benzene hexachloride over cryolite was not nearly so marked when used against third and fourth instar worms. For third and early fourth instars, benzene hexachloride was no better than cryolite when only the leaves were dusted. When the leaves and worms were dusted, however, benzene hexachloride did cause a higher mortality than cryolite. This superiority became less evident as the worms became older, until it disappeared altogether with late fourth and early fifth instar worms.

(4) There was some evidence that Toxaphene was more toxic than benzene hexachloride or cryolite against third and fourth instar larvae.

(5) Chlordane was less effective than cryolite for the older bagworms.

(6) It has been shown in a previous publication (5) that the deposit of natural cryolite required to give a lethal dose to third instar worms is nearly twice that for first and second instars and very much more for instars beyond the third. It is evident from the results given in Table 1, therefore, that dusting with cryolite, benzene hexachloride, chlordane or Toxaphene should, if possible, be completed before many of the worms have entered the third instar.

Fumigating Effect of B.H.C.

It is well known that certain chlorinated hydrocarbon insecticides, and benzene hexachloride in particular, act as contact and stomach poisons and in addition have a fumigant effect on insects. The question therefore arose whether or not the superiority of benzene hexachloride over cryolite in the laboratory tests just described was not due, in part, to its fumigating effect. It was felt that if fumigation was a factor in causing mortality it would operate to a far greater extent in closed tubes, such as those used in the laboratory, than under field conditions and that the results would, therefore, not be a true reflection of the relative efficacy of cryolite and benzene hexachloride. Experiments were, therefore, undertaken to elucidate this point. The experimental procedure was as follows:—

In each test, 80 leaves were dusted at the rate of 10 lb. per acre, and they were then placed separately in specimen tubes. In half of the tubes bagworms were confined, one to a tube, so that they could come in contact with and feed on the dusted foliage. In the other 40 tubes, the worms were separated from the dusted foliage by means of coarse wire mesh and were fed on untreated leaves. The tubes were plugged with cotton wool as in the previous experiments. The worms coming in contact with the treated leaves were subjected to the combined contact, stomach and fumigating effect of benzene hexachloride, whereas those separated from the dusted foliage had only the fumigating effect.

TABLE 1.—*Dusting Tests on the Wattle Bagworm.*

Expt.	Instar Worms.*	Dosage (lb. p. acre).	PERCENTAGE FINAL MORTALITY.							
			Cryolite.		5 Per cent B.H.C.		5 Per cent. Chlordane.		5 Per cent. Toxaphene.	
			Leaves Dusted.	Leaves and Worms Dusted.	Leaves Dusted.	Leaves and Worms Dusted.	Leaves Dusted.	Leaves and Worms Dusted.	Leaves Dusted.	Leaves and Worms Dusted.
1	1st and 2nd....	7	83·3	83·3	—	100·0	—	96·6	—	100·0
2	2nd............	7	63·3	66·6	96·6	100·0	96·6	91·7	83·3	—
3	2nd............	5	53·3	—	100·0	—	86·6	—	83·3	—
4	3rd............	7	43·3	—	40·0	—	26·6	33·3	50·0	56·6
5	3rd and 4th.....	10	73·3	—	60·0	—	33·3	—	—	—
6	3rd and 4th.....	10	43.3	—	40·0	53·3	—	—	60·0	—
7	3rd and 4th.....	9	46·6	—	56·6	63·3	—	—	66·6	—
8	Mainly 4th.....	10	70·0	—	—	73·3	—	36·6	—	—
9	Mainly 4th.....	10	—	—	—	66·6	—	—	—	—
10	Late 4th and 5th	10	30·0	—	20·0	33·3	—	—	—	—
11	Late 4th and 5th	10	30·0	—	26·6	33·3	—	—	—	—

* For readers not familiar with entomological terms it might be explained that the bagworm moults several times during growth. The worm between hatching and the first moulting is known as the first instar; between first and second moultings we have the second instar and so on.

After 24 hours the insects were transferred to clean tubes and fed on untreated foliage. Mortality was recorded at 24-hourly intervals.

Results.

The results are presented in Table 2.

TABLE 2.—*Testing the fumigating Effect of B.H.C.*

Expt.	Instar Worms.	Dosage (lb. per Acre).	Percentage Final Mortality.	
			Worms Fed on Dusted Leaves.	Worms Separated from Dusted Leaves.
1	3rd....................	10	56·6	0·0
2	3rd....................	10	60·0	6·6
3	3rd and 4th...........	10	40·0	4·7

Conclusions.

The results indicated that with the technique used in these tests no appreciable mortality could be attributed to the fumigating effect of benzene hexachloride and the mortality was due, therefore, to the combined stomach and contact effect of the insecticide.

(II). The Pine Brown Tail Moth (*Euproctis terminalis* (Walk.)

Euproctis terminalis, popularly known as the pine brown tail moth, is indigenous to South Africa and is the most serious pest of conifers in the Union. It is responsible for defoliating hundreds of acres of pines and has a widespread distribution. The defoliation of the trees causes a severe set-back to growth and results in loss of increment and vigour.

Extensive experiments on the control of *Euproctis terminalis* by chemical means were started by F. G. C. Tooke, Forest Entomologist of the Division of Entomology, as early as 1931 (6). It was found that calcium and lead arsenate were, at that time, the most promising insecticides for the control of this pest. In recent years, however, the search for new insecticides has resulted in the release of several new compounds into the field of chemical control of insects, and it was felt that these might prove more effective than the insecticides previously used.

The insecticides tested were 5 per cent. benzene hexachloride, 5 per cent. D.D.T., 5 per cent. chlordane, 5 per cent. Toxaphene and lead arsenate, applied at the rate of 0·11 and 0·16 mg. per sq. cm., which is the equivalent of 10 and 15 lb. per acre in field application.

Both the insects and the pine needles on which they were fed were dusted and the technique and experimental procedure was the same as that used in the tests with the wattle bagworm. 40 fourth instar larvae were used for each insecticide in each experiment.

Results.

The results obtained with the different insecticides are given in Table 3.

Conclusions.

(1) D.D.T., Toxaphene and lead arsenate were more effective than benzene hexachloride and chlordane at the concentration and rates of application used in these tests.

(2) 5 per cent. Toxaphene was slightly more toxic than either 5 per cent. D.D.T. or lead arsenate. The latter two insecticides produced similar final mortalities, but D.D.T. was more rapid in action than lead arsenate.

(3) 5 per cent. benzene hexachloride was more effective than 5 per cent. chlordane.

(4) The results suggest that, of the insecticides tested, Toxaphene, D.D.T. and lead arsenate would afford more effective control against *Euproctis terminalis* than either benzene hexachloride or chlordane.

TABLE 3.—*Dusting Tests on the Pine Brown Tail Moth.*

Expt.	Insecticides.	Dosage (lb. per Acre).	Percentage Final Mortality.	Time required for Percentage Final Mortality.
1	5 Per cent. Benzene hexachloride	10	37·7	144 hrs.
	5 Per cent. D.D.T.		51·1	144 hrs.
	5 Per cent. Chlordane		28·8	144 hrs.
	5 Per cent. Toxaphene		61·7	120 hrs.
	Lead Arsenate		—	—
2	5 Per cent. Benzene hexachloride	10	41·6	144 hrs.
	5 Per cent. D.D.T.		62·1	120 hrs.
	5 Per cent. Chlordane		36·6	120 hrs.
	5 Per cent. Toxaphene		66·4	120 hrs.
	Lead Arsenate		64·7	168 hrs.
3	5 Per cent. Benzene hexachloride	15	47·3	120 hrs.
	5 Per cent. D.D.T.		78·8	120 hrs.
	5 Per cent. Chlordane		46·0	120 hrs.
	5 Per cent. Toxaphene		84·4	120 hrs.
	Lead Arsenate		—	—
4	5 Per cent. Benzene hexachloride	15	55·5	120 hrs.
	5 Per cent. D.D.T.		81·7	120 hrs.
	5 Per cent. Chlordane		40·7	120 hrs.
	5 Per cent. Toxaphene		85·6	120 hrs.
	Lead Arsenate		83·3	192 hrs.

(III). The Bollworm (*Heliothis armigera.*)

The American bollworm, *Heliothis armigera,* is a pest of great economic importance in South Africa. It is commonly found attacking not only cotton, but also lucerne, maize, tomatoes, peas and citrus. It causes a good deal of damage to ordinary garden plants and is a serious pest in the buds of carnations. It is known by a variety of names, such as tassel worm or earworm of maize, tomato fruit-worm, etc.

The insecticides tested were 2 per cent. Thiophos 3422, 5 per cent. Benzene hexachloride, 5 per cent. D.D.T., 5 per cent. Chlordane and natural cryolite, applied at the rate of 0·22 mg. per sq. cm., which is equivalent to a field application of 20 lb. per acre.

Both the insects and their food plant, in this case fresh maize cobs, were dusted and the caterpillars were confined in cages with the treated food for 24 hours. Thereafter they were transferred to clean cages with untreated maize cobs and the mortality was recorded at 24-hourly intervals. 30 half-grown larvae were used for each insecticide in each experiment.

Results.

Table 4 summarises the results obtained.

TABLE 4.—*Dusting Tests on the Bollworm.*

Expt.	Insecticides.	Dosage (lb. per Acre).	Percentage Final Mortality.	Time required for Percentage Final Mortality.
1	5 Per cent. Benzene hexachloride	20	74·9	48 hrs.
	5 Per cent. D.D.T.......		95·7	48 hrs.
	5 Per cent. Chlordane...		81·4	48 hrs.
	2 Per cent. Thiophos 3422		88·6	48 hrs.
	Natural cryolite.........		89·4	96 hrs.
2	5 Per cent. Benzene hexachloride	20	66·6	72 hrs.
	5 Per cent. D.D.T.......		100·0	48 hrs.
	5 Per cent. Chlordane...		91·7	48 hrs.
	2 Per cent. Thiophos 3422		94·5	48 hrs.
	Natural cryolite.........		98·6	96 hrs.
3	5 Per cent. Benzene hexachloride	20	73·6	48 hrs.
	5 Per cent. D.D.T.......		100·0	48 hrs.
	5 Per cent. Chlordane...		89·3	48 hrs.
	2 Per cent. Thiophos 3422		96.5	48 hrs.
	Natural cryolite.		94·6	96 hrs.

Conclusions.

(1) D.D.T. was more effective than Thiophos 3422, natural cryolite, chlordane and benzene hexachloride at the concentrations and rate of application used in these tests.

(2) 2 per cent. Thiophos 3422 and natural cryolite caused similar final mortalities, but natural cryolite was slower in action than Thiophos 3422.

(3) 5 per cent. chlordane was slightly less toxic than either natural cryolite or 2 per cent. Thiophos 3422, while benzene hexachloride proved to be the least effective of the insecticides tested.

(4) The results suggest that control of the bollworm, *Heliothis armigera,* should be obtained by the application of 5 per cent. D.D.T., 2 per cent. Thiophos 3422, natural cryolite or 5 per cent. chlordane, applied at the rate of 20 lb. per acre. At the rate of application used, 5 per cent. benzene hexachloride appeared to be too weak a concentration for effective control.

(IV). *Aphis Sp.*

The species of aphid used in these experiments has not yet been determined but the insect is probably *Aphis leguminosae.* It was found attacking cowpeas and groundnuts.

The insecticides tested were 5 per cent. benzene hexachloride, 5 per cent. D.D.T., 4 per cent. nicotine and 2 per cent. Thiophos 3422. The dusts were applied at the rate of 0·16 mg. and 0·22 mg. per sq. cm., which is equivalent to 15 and 20 lb. per acre.

The aphids and their food plant were dusted and the insects were confined in cages with the treated foliage. The percentage "knock-down" was recorded every hour for a period of six hours and mortality records were taken at 24-hourly intervals. Approximately 100 adult aphids were used for each insecticide in each experiment.

Results.

The results of these tests are given in Table 5.

TABLE 5.—*Dusting tests on Aphis sp.*

Expt.	Insecticides.	Dosage (lb. per Acre).	Percentage Final Mortality.	Time required for Percentage Final Mortality.
1	5 Per cent. Benzene hexachloride	15	94·6	72 hrs.
	5 Per cent. D.D T.......		87·5	72 hrs.
	4 Per cent. Nicotine.....		100·0	24 hrs.
	2 Per cent. Thiophos 3422		100·0	48 hrs.
2	5 Per cent. Benzene hexachloride	15	93·7	72 hrs.
	5 Per cent. D.D.T		84·3	96 hrs.
	4 Per cent. Nicotine.....		100·0	24 hrs.
	2 Per cent. Thiophos 3422		99·4	48 hrs.
3	5 Per cent. Benzene hexachloride	20	96·7	48 hrs.
	5 Per cent. D.D.T......		90·4	72 hrs.
	4 Per cent. Nicotine.....		100·0	24 hrs.
	2 Per cent. Thiophos 3422		100·0	48 hrs.
4	5 Per cent. Benzene hexachloride	20	100·0	48 hrs.
	5 Per cent. D.D.T.		87·5	72 hrs.
	4 Per cent. Nicotine.....		100·0	24 hrs.
	2 Per cent. Thiophos 3422		100·0	48 hrs.

Conclusions.

(1) Nicotine, Thiophos 3422, benzene hexachloride and D.D.T. were all highly toxic to the aphids at the concentrations and rates of application used.

(2) Taking rapidity of action and final mortality into consideration, 4 per cent. nicotine dust was superior to 2 per cent. Thiophos 3422, 5 per cent. benzene hexachloride and 5 per cent. D.D.T.

(3) 2 per cent. Thiophos 3422 was more effective than 5 per cent. benzene hexachloride and 5 per cent. D.D.T.

(4) Benzene hexachloride caused a quicker rate of mortality and a higher final mortality than did 5 per cent. D.D.T.

(5) The results suggest that 4 per cent. nicotine, 2 per cent. Thiophos 3422, 5 per cent. benzene hexachloride and 5 per cent. D.D.T. should be effective in reducing infestations of this species of aphid when applied at the rate of 15 to 20 lb. per acre.

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Coccidiosis.

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THOUGH all domestic birds and probably all wild birds suffer from coccidiosis, the disease is of economic consequence only in the fowl. Let us say at once that the disease in any one bird is specific for that species. In other words, coccidiosis of pigeons is not dangerous to fowls, and coccidiosis of turkeys will not affect ducks, and so on. This, of course, does not mean that sparrows, for instance, cannot carry the germs of fowl coccidiosis from farm to farm mechanically on their feet.

There is another very important point. Coccidiosis is a general term covering a large number of very closely allied diseases due to just as closely allied parasites affecting the intestines. In the fowl there are eight known forms of coccidiosis and, unfortunately, when a bird recovers from one form, it is not immune to the others. This means that a single flock of fowls may suffer two and even three times from coccidiosis, but it is unusual for the birds to be affected more than twice. The first attack is likely to be at the age of 6 to 8 weeks and the second at about the time the pullets start laying. All eight forms of coccidiosis are not equally dangerous and the symptoms and post-mortem appearances vary considerably. Indeed, the one common feature in regard to all sorts of coccidiosis is the method employed to combat them.

Origin of Coccidiosis on a Farm.

Even on the best managed poultry farms, coccidiosis is almost certain to appear sooner or later. The dung of an infected bird is full of the parasites and as these germs are tough and can survive in the soil for perhaps a year, it is easy to understand how the infection is brought on to premises on the feet of birds and dogs and on the footwear of man. It is only necessary to bring a very few parasites on to a farm. These cause an inapparent infection in one bird (for the severity of the disease depends on the number of the germs ingested, as well as on the species of these germs), and then the numerous parasites passed out by this bird are swallowed by other birds, which in due course develop the usual frequently fatal symptoms.

The infection can also be introduced by carriers which generally look perfectly healthy. Some recovered fowls go on harbouring a few parasites for months and may be responsible for epidemics. This is one reason why farmers should not bring fowls, other than day-old chicks, on to their premises. Coccidiosis germs do not pass through the egg.

Symptoms and Post-Mortem Appearances.

Coccidiosis is seldom seen in chicks less than a month old. The most common form found in young birds affects the two blind pouches (ceaca) of the intestine, which usually contain a varying amount of blood. It is always essential to slit the intestines with a pair of scissors when examining a bird for any form of coccidiosis. Affected chickens mope, have diarrhoea, which is often bloodstained, and die in a day or two. Sometimes they are very pale due to bleeding into the caeca. Chicks may also mope, suffer from diarrhoea (not bloodstained), and die as a result of another form of coccidiosis involving the small intestine. If the gut is opened and the contents flushed away with water, narrow, transverse, greyish bands may be seen on the inner lining of the intestine.

Coccidiosis.

Contrary to popular opinion, chickens do not succumb so frequently to coccidiosis as do older birds, particularly pullets just commencing to lay. These look mopy, develop bluish combs, show diarrhoea which is often bloodstained, and die in a day or two. Here the small intestine (for about 18 inches behind the gizzard) is ballooned because of the loss of tone of the gut wall. When this intestine is slit open, it is seen to be full of bloody material, or material resembling bloodstained wet bran. Now and again the gut contents consist only of a considerable quantity of mucus, that may have a somewhat tough consistency.

Since it is easy for a layman to confuse the different forms of coccidiosis with diseases such as fowl typhoid and visceral gout, the farmer will be well advised to adopt preventive measures immediately an outbreak is suspected. He should at the same time despatch sick and dead birds to the laboratories at Ondersteport or Pietermaritzburg for a confirmatory diagnosis.

Control of Outbreaks.

Let us say at once that there is no vaccine and no form of drug treatment, and disinfectants are of remarkably little value.

The following facts in connection with coccidiosis should be borne in mind: —

(*a*) The severity of the disease depends on the species of the parasites concerned and on the *number* of parasites swallowed by the bird.

(*b*) The droppings containing the parasites are not dangerous until they have been lying around for approximately 24 hours.

(*c*) The parasites ingested by the fowl do not go on multiplying for more than a short period, and so the lesions must begin to heal unless further parasites are swallowed.

(*d*) A reasonably good immunity develops after 2 to 3 weeks.

(*e*) Soil cannot be sterilized.

In view of the above, the following measures should be adopted for the control of the disease: —

(1) Get all the birds involved on to a wire-netting or wooden or cement floor at once, and do not allow them on the soil.

(2) Kill any fowls looking very ill and keep the rest warm and dry.

(3) Feed mash, and sweet or sour milk if possible, but withhold grain and greenfeed until the attack seems to be over.

(4) Do not allow droppings to fall into the food and water receptacles. If some infected dung falls into the mash and remains there for a day, this contaminated mash should be discarded. It is best to put out just enough mash in the morning to last one day and to clean out all food and water receptacles daily.

(5) The most important step of all is to sweep all droppings out of the house at approximately the same time every day. It is not necessary to wash the floors. Sweeping is facilitated by throwing a little fresh litter on to the clean floor every morning. The droppings must be buried. The daily cleaning is kept up for a week. During the following week the house is cleaned on alternate days. After a fortnight it is generally safe to revert to the usual routine allowing the birds outside on the soil, if necessary. The idea of the daily cleaning is to remove the parasites before they have developed to the dangerous stage. The birds will in the ordinary course of events swallow a few, but this is desired as they will then become immune without getting ill.

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Phenothiazine: A Remedy for Internal Parasites.

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ALTHOUGH the drug phenothiazine has for several years been used in America, Canada, Australia, England and elsewhere for the control of internal parasites in domestic animals, it has only after the last war become available in South Africa, and this Division has had to answer a considerable number of questions concerning its efficacy and method of application.

Extensive tests have been carried out by the Division and these have shown that the remedy is very effective, especially against wireworms and nodular worms in sheep, and wireworms and the red roundworms of horses. In many cases it proved more effective than remedies that have been used up to now for combating worms in animals. The remedy is unfortunately expensive and bulky, so that it is cumbersome to dose sheep unless a special dosing syringe or pistolet is used.

The remedy is available in two forms, viz., in powder and in tablet form. Tablets are easier and cleaner to use, but more expensive than the powder. The pure drug is insoluble in and does not mix with water and therefore a wetting agent must be added to the powder, which can then be mixed to a thin paste with water before being administered. If no wetting agent is available, a paste may be made by mixing the powder with soft or rain water containing 1 per cent. yellow soap in solution.

The doses, method of application and efficacy of the drug for various animals, are discussed below.

Sheep and Goats.

For these animals the dose is 20 to 25 grams * for a full-grown animal and 10 to 15 grams for lambs 4 to 9 months old; the smaller dose is effective for worms in the milk stomach (abomasum) if given after a small dose of 10 per cent. copper sulphate solution (1 lb. to a gallon, or 2 ounces to a pint of water). The larger doses must be used for worms in the intestines; here too the drug may be administered after a dose of copper sulphate solution, although this is not essential.

To prepare the paste, 4 lb. of the powder is rubbed through a sieve to remove any lumps, and then stirred into 5 pints of clean, cold water to form a thin paste. From 1 to 1½ ounces of this paste for lambs and 2 ounces for full-grown sheep will be approximately the correct doses. After the paste has been mixed, it should be stirred occasionally, for the powder is inclined to settle. The above-mentioned quantity is sufficient for dosing about 80 full-grown sheep or from 120 to 160 lambs once, and its cost will be approximately 25s. The remedy can be administered with a 2-ounce dosing syringe or pistolet with a leather washer (not metal), or with a 2-ounce medicine bottle or a funnel provided with a rubber tube 6 inches long to which must be attached a metal tube 4 inches long. If the tube is too narrow, the paste will block it and will have to be diluted with a little water. In this case the dose must be increased accordingly.

* *N.B.*—One ounce by weight is equal to approximately 30 grams, and one ounce of liquid approximately 30 c.c.

The remedy is practically 100 per cent. effective for the control of all round worms occurring in the abomasum, viz., wireworms, brown stomach worms and bankrupt worms, as well as large-mouthed worms and nodular worms in the intestines; it is considerably less effective in the treatment of bankrupt worms and hookworms in the small intestine, although still a good remedy against these parasites. It is *not effective* against *long-necked worms, flukes,* or *tapeworms.*

Small stock can be treated at any time, and it is not necessary to keep them away from feed or water before or after treatment. Animals in very poor condition or those suffering from anaemia must receive only half the full dose. *If the farmer is using the remedy for the first time, it is advisable to test it out on about* 10 *animals of varying age and condition.* If the effect is injurious the dose must be reduced. Ewes expected to lamb within a month should not be dosed.

Since the remedy is expensive and not easy to administer, sheep farmers will in practice be able to dose animals only once or very few times a year; if only one annual treatment is applied, it should take place just before the winter, to enable the sheep to survive the winter in a comparatively worm-free condition. If more treatments are desired, they should be given in September-October and in January-February.

This remedy is no preventative; it will destroy the worms in the intestines of the animals, but will not prevent reinfestation if the animals graze on infested veld. It is advisable therefore to treat the animals with Tetram and Nodular Worm Remedy every three weeks after the administration—once with Tetram and two or three times with Nodular Worm Remedy. If the animals receive salt and a bone-meal lick, one part of phenothiazine may be mixed with nine parts of the lick. The amount of the drug which each animal ingests with the lick is sufficient to curb egglaying and will counteract the development and hatching of worm eggs in the manure, but is insufficient to destroy the worms in the animals.

This practice will help to reduce infestation of the veld.

Cattle.

The dose for full-grown cattle is 30 to 40 grams and for calves 15 to 20 grams; which means that a full-grown animal will receive 3 to 4 ounces and a calf 1½ to 2 ounces of the paste as prepared for sheep and goats. Before administering the remedy, cattle can be given half a cup of a 10 per cent. solution of table salt. The efficacy of the drug is as explained under the heading "Sheep and Goats", and the same rules apply to cattle.

Horses.

The remedy is very effective against most parasites of horses, such as small roundworms (*Trichonema* species) and red roundworms (*Strongylus* species and, to a certain extent, the large roundworm (*Ascaris*), bankrupt worms and pinworms. The dose is 25 grams for a full-grown horse, 15 grams for yearlings and 10 grams for a foal 9 months old—younger foals should not be treated with the drug. The best and most effective method is to divide each dose into five equal portions and to give the horse one portion mixed with a little bran every morning for five consecutive days.

Pigs.

In pigs the drug is very effective against nodular worms and to a certain extent against the roundworm (*Ascaris*). The required dose for each pig is mixed with the animal's feed, the pigs being fed separately

to ensure that each receives the correct quantity. The doses are as follows:—

5 grams for piglets weighing 25 lb.
8 grams for piglets weighing 25 to 50 lb.
12 grams for pigs weighing 50 to 100 lb.
20 grams for pigs weighing 100 to 200 lb.
30 grams for pigs weighing over 200 lb.

If the doses for a number of pigs are mixed with the feed where pigs feed together out of a trough, some animals may ingest more than the prescribed dose, with the result that undesirable symptoms, such as inco-ordination or even partial paralysis of the hindquarters or temporary blindness may appear.

Fowls.

The drug is very effective against caecal worms, and, to a large extent also against *Ascaridia* in fowls. The dose is 0·5 gram per fowl. It may be mixed with the feed or, better still, administered in the form of a tablet; a quarter of a pound mixed with the quantity of feed which fowls will eat up within half an hour or less, will be sufficient for approximately 200 to 250 fowls.

Warning.

Except in the case of horses, there is very little danger of poisoning, for in most cases, other animals can take in much more than the prescribed dose without any harmful effects. Care must, however, be taken with horses, especially thoroughbreds, and a veterinary surgeon should supervise the treatment; in no circumstances should horses be given more than the prescribed dose, since they are inclined to develop anaemia.

Animals suffering from anaemia or kidney, liver or heart trouble should not be treated with this drug.

Phenothiazine is insoluble in water, but slightly soluble in the intestinal juices. Therefore an animal which has been treated with the drug may, for the following few days, pass urine of a reddish colour, resembling that of the remedy itself. In dosing sheep, care must be taken to prevent staining of the wool for the discolouration may be permanent and the wool rendered unsuitable for marketing.

The remedy is not offered for sale by the Division, and consumers will have to order it, together with the dosing instruments direct from registered dealers.

Coccidiosis:—

[*Continued on page* 399.

Fowls on range can also be saved from the ravages of coccidiosis. This is done by moving the food and water receptacles a couple of yards on to clean ground each day. When receptacles are kept on one spot, manure accumulates on the adjacent soil and so healthy fowls can easily become infected. If the portable shelters are without wire or other floors to prevent the birds frequently coming into contact with their own droppings, they must also be moved a few paces every day.

Our aim is thus to allow fowls to swallow enough parasites to give them an immunity, but not sufficient to make them sick, and this is achieved by assiduously enforcing the measures enumerated above.

It is emphasized once again that some lesions, even in fatal cases of coccidiosis, are extremely difficult for the farmer to detect, and so laboratory confirmation of the diagnosis is most desirable.

Cape Fur Seals.

R. W. Rand, Biologist, Government Guano Islands.

THE existence of fur-seal rookeries, varying considerably in size and situation, and widely-spread round the South African coast and northwards to Cape Cross, has led to the establishment of an industry which has fluctuated for nearly 300 years. In spite of the exploitation that has befallen these animals, relatively little is known about their habits and the populations existing today in favourable localities.

FIG. 1.—Sea herd composed mainly of adult females and immature males lying on a ridge. Sinclairs Island.

The Cape Fur Seal (*Arctocephalus pusillus*, Schreber) is a typically South African species confined to the coastal zone, but ranging for considerable distances from the rookery area. No large-scale migration occurs, and the seals resort to the miscellaneous rocks, islets or even stretches of desert coast throughout the year, perhaps more so during the summer when reproductive activities are at their height. Large herds can to-day be seen on Dyers, Sinclairs and Long Islands, and further north at Hollamsbird Island and Cape Cross. All rookeries fall under the aegis of either the Union Government or the South-West African Administration. Private sealing enterprise is, however, conducted on certain rocks under permits granted by the respective governments.

Breeding Habits.

Large numbers of seal congregate on suitable rookeries during the summer breeding season (October-January), but a noticeable decrease is apparent when the herd disperses in the autumn: during inclement weather the animals often return to the safety of the old rookeries, but withdraw again immediately at the onset of calm seas.

Sexual periodicity is most conspicuous in the species, mating and breeding being confined to a well-marked season which recurs rhythmically at the same time of the year (October-December). The herd during the breeding season is initially a complex of polygynous groups in which the large bullseals dominate as many pregnant females as their abilities admit. These groups (harems) are formed round such bulls as had previously arrived to establish territorial claim to favourite ledges in the rookery area, which will be resorted to by parturient females. Pregnant females arrive some days after the bulls have established themselves, and pup shortly after arrival at the rookery. The females give birth to one pup only, and within a few days are again in rut and ready to receive the male. Parturition had occured in the harem area and the females are constrained by the bull to remain in the group until they have been impregnated. Bull seals prohibit trespass of their territory by other bulls,

FIG. 2.—Adult female seals with week-old pups.

and the continual clamour caused by aggressive males attempting to displace those already among the females results in a high state of excitement throughout the herd. The bulls are in superb condition when they reach the rookery, and the accumulation of subcutaneous blubber enables them to abstain from food during the few weeks that they require to serve the females and guard their harems against the depredations of other males.

The strict harem control (overlordship) gradually disappears as the females are all impregnated and the herd becomes a more social (gregarious) unit, containing representatives of all ages. Previously the herd had been exclusively adult females confined to confluent hierarchies established by the breeding bulls. As the adult males disperse to sea or

relax, the aggressive control so fiercely exercised initially, the immature males become more abundant and tend to form unisexual groups adjacent to the main (female-pup) herd. As the pups grow and are able to move about freely, the various classes are seen associating freely. The bulls have by now lost all their previous aggressiveness and spend their time on land indolently scattered among the other seals whose company they desire.

Moulting and Coat Colours.

The herd continues to be fairly large throughout autumn when the animals undergo their annual moult. This is a complete shedding of the old coat—a process which generally takes about six weeks. Moulting animals may be seen from December to April. The younger classes shed their hair before the adults, and a complete coat-colour change results. In the males the new gray coat rapidly darkens as the animals age, but in the females warmer colours predominate. In the second-year animals, the rich gray coat contrasts strikingly with the faded isabelline coat which is shed in the summer. Coat colours at this period present some remarkable individual variations, but gradually the herd assumes a more

FIG. 3.—Part of herd showing adult females with black pups, and large bulls. Sinclairs Island.

uniform olive-brown appearance. Black pups also lose their natal coats about this time (at the age of about 90 days), replacing the black curly hair by a soft olive-gray coat which is the much-prized yearling pelt.

Feeding Habits.

As the adult herd spends a considerable part of its time at sea, the rookery frequently contains a high percentage of pups. These little animals resort to the sea round the island after a few weeks of playing in smaller pools at the water's edge. They gradually extend their

activities, exploring all the pools and finding suitable areas in which to frolic and develop their amazing swimming potentialities. Concomitantly with the natal moult, pups lose their milk dentition, but are not weaned till some months later. Cases occur when the milk diet is continued till terminated by the following breeding season when the cows are preoccupied by another litter.

Diet seems to be exclusively cephalopod and fish: the yearlings supplement their milk diet by such crustacea (red crabs and crayfish) as they are able to forage on the seaweed covered reefs lying in the vicinity of the island rookery, but as they grow older the diet changes to one of cephalopod and fish obtained at sea or from feeding areas some distance from the rookery. Digestion is rapid and stomachs examined on the rock rarely contain identifiable remains.

The herd is composed of animals which on inspection can be allocated to definite age groups: sex discrimination after the first year is not difficult. Among the males especially, increase in body-size is much greater than in the females. Such discrepancies in size and sex greatly assist in assessing individual animals and identify the components of the herd. Mature or adolescent females can be identified, and breeding bulls are immediately recognised. Females reach puberty at the end of their second year. Males are probably capable of service at the same age, but are seldom able to exercise their breeding capacities till they reach adult stature in the fifth or later years.

Sealing Operations.

It is during the summer when such large numbers of male seals congregate on the rocks and islands and lose their fear of man, that sealing operations are conducted on a three-fold basis, the object being to obtain blubber, for subsequent extraction of oil, skins, and livers, for vitamin extraction. The sealing season lasts about six weeks, after which the condition of the remaining bulls is such that processing the blubber is uneconomical: the skin of the adult male is invariably scarred to some extent, owing to lacerations sustained in combats with other males on or about the rookery. Bulls arriving at the onset of the breeding season are superbly fat, the blubber weight alone being more than 100 lb.: in a few weeks of living on this stored food-supply, the blubber has decreased to about 30 lb. and little oil can be extracted. The tempo of sealing is dependent upon this phenomenon, and after the end of November bull seals are so thin and scraggy that sealing is unprofitable. This limitation upon sealing enterprise is further curtailed by adverse weather which may seriously reduce the number of working days. In the winter months, "pup" sealing is conducted for the purpose of obtaining the valuable pelts especially.

Sealing operations are conducted either at the rookery (as on Sinclairs Island) where beaming and trying is completed and the livers and other products stored before shipment to Cape Town. Or else the sealing crew is transported from a base (e.g. a convenient guano island or on the mainland) to the distant rocks. This latter method, one dictated by the vicissitudes of the rookeries themselves, is the one more commonly used. The sealers despatch and flay the animals on the rookery, skins and other products being transported to the waiting boat, and beaming and trying of blubber only done later at the base station. It is here that considerable curtailment and loss of working hours is experienced by the onset of inclement weather making work on the seal rocks impossible. Nevertheless experienced sealers, men accustomed to the vagaries of weather and work, are able to set a fast pace and achieve remarkable results.

Hygiene on the Poultry Farm.

J. D. W. A. Coles, Research Officer, Onderstepoort.

SO many misconceptions exist on the subject of hygiene on the poultry farm, that it will not be a waste of time to deal with the matter fairly extensively. To begin with, it should be stated that drugs are of negligible value when it comes to keeping fowls healthy or to curing them of disease. It is simply worthless medicating the water with potassium permanganate, aloes, etc., and the regular use of Epsom salts is a ludicrous custom.

The Ground.

Soil becomes contaminated by droppings containing the germs of typhoid, tuberculosis, coccidiosis and B.W.D., and also worm eggs. Nasal secretions harbouring the bacteria of roup and cholera may also infect the ground. If the birds are absolutely free of these diseases, the ground will not become a danger, even after years. Nature is no conjurer, and disease-producing agents do not materialize out of thin air.

As the cost is prohibitive, chemical disinfectants of sufficient strength and in sufficiently large quantities cannot ordinarily be employed to sterilize the soil. Liming is useless, and sowing a crop is a waste of time. Digging the ground over actually protects many germs from the influence of the sun and air, and should thus be discouraged. When ground is infected, the wisest course is to leave it severely alone for eighteen months, because nearly all the worm eggs and disease germs will die out within that time. *Thus, to render dangerous soil harmless, let it stand idle for a year and a half,* or use it for anything else but poultry.

Many a person, buying land or even a poultry farm, enquires how long the premises should be left vacant in order to ensure that no disease-producing organisms are left to infect new stock. The answer is obvious—eighteen months. In the rare case of tuberculosis, however, this period has to be doubled. Tampans have been known to survive, without sucking blood, for as long as four years, but they can be dealt with by spraying.

Does it help to remove apparently healthy fowls to clean ground when a disease breaks out? Sometimes it is of value when coping with coccidiosis, because the severity of this disease depends largely on the number of parasites actually swallowed. It is, however, futile to attempt to check typhoid, B.W.D., tuberculosis, roup, chicken-pox and worm infestations by transporting the birds from the old environment. An apparently healthy bird may be in the incubation period of the disease, or be merely a carrier of the germs, and so many innocent-looking fowls will contaminate the new ground within the first few hours.

The soil constitutes a menace to the good health of fowls. Even on the best-run poultry farms we have to contend with the ubiquitous germs of coccidiosis. So it behoves us not to make matters worse by throwing feed into the litter. Give the greenfeed in clean troughs in the morning and use the same clean troughs for the grain in the evening. Fowls get quite enough exercise in other ways without having to dive into the litter after mealies liberally smeared with infected droppings.

If you fertilize land with dangerous fowl manure, expect to find diseases appearing in birds fed on the greenfeed grown on such land.

One last word about the ground. Farmers and their servants should keep away from other people's poultry, so as not to bring infection back on their clothing or feet. It is a good idea to keep special shoes or sandals for those who have to work with the fowls.

The Drinking Water.

A queer belief exists that it is dangerous to let fowls drink water that has been standing in the sun. Cool water is more refreshing, but it has no other recommendation. Unless infected droppings and nasal secretions have contaminated the water, it will not harm the birds. Even smelly or slimy water will do no damage provided the germs of coccidiosis, typhoid and other diseases have not been allowed to enter it. If any doubt exists, boil the drinking water for five minutes before pouring it into the clean troughs. Do not rely on adding a pinch of chloride of lime to a bucket of water as so many farmers do. Best of all, see that the water is obtained from a source that cannot be polluted by domestic poultry or wild birds.

Houses and Equipment.

These should be constructed according to approved designs which may be had from the local College of Agriculture.

The houses should be airy, but free of draughts. Avoid cement nests and cement dropping boards, which are extremely cold in winter.

Many farmers imagine there is something sinister about wood. Tampans and red mites occur just as commonly in houses where not a bit of wood is to be seen. There is nothing against wood, provided the cracks are filled with tar, but even treatment with tar or carbolineum is unnecessary if external parasites are absent. Wood is excellent for perches, nests and mash hoppers, not to mention purlins.

A smooth impervious floor, such as a concrete one, is indispensable if the hygiene is to be good. If houses and their equipment have to be "sterilized", nothing better can be done than to scrub everything thoroughly a couple of times, using plenty of uncontaminated water. End up by hosing everything down. Disinfectants are unnecessary, but the money saved on them should be devoted to providing proper drains to carry off the dirty water from the houses. A blowlamp is not a satisfactory instrument for destroying germs, even though its flame may kill a few tampans. Play the flame for a minute on one small section of a concrete floor. Then touch the floor and you will find that it is still cold!

Incubators may be disinfected with formalin, particularly if B.W.D. or fowl typhoid is present on the farm; details will be found in the pamphlet on B.W.D., obtainable from the Director of Veterinary Services, Onderstepoort.

Crates returned from markets and farms should be sprayed thoroughly to destroy any lurking tampan larvae. For this use one of the new benzene hexachloride dips diluted as for the dipping of cattle. Re-spray the crates next day with a 5 per cent. carbolic solution.

Only new chick boxes should be used. If these are unobtainable, the dirty boxes must be cleaned up well with a firm brush, and then sprayed all over, inside and outside, on two consecutive days with 5 per cent. carbolic or 2 per cent. formalin solution.

Carbolic and formalin injure the skin and so may be applied by means of a piece of cotton wool attached to the end of a stick. Formalin also irritates the eyes and nose, and it is best to do this work out-of-doors.

Breeding.

Breed only from second-season cocks and hens in order to produce chicks for *yourself*. The various forms of cancer together may account for over 40 per cent. of the deaths of adult fowls during the first laying year. Over 90 per cent. of birds doomed to die of cancer fall victims to the disease before the age of 600 days. So, if a farmer breeds always only from second season cocks and hens, he will breed from his more resistant stock and so rapidly build up a flock of fowls of sound constitution. Naturally, pullet matings are necessary to produce sufficient chicks for sale, but these pullets and cockerels will be superior to the usual run of fowls, if the advice just given is accepted. If individual records are kept, breed chicks for yourself only from females laying over 200 eggs during the pullet year.

Eliminate hens with abnormal or light eyes, spurs, side-sprigs, stubs, crooked keels and other serious blemishes.

Cull birds that go broody and do not conform to the characteristics of the breed. Set only eggs that are large (2 to $2\frac{1}{2}$ ozs.) and well formed and have good shells. Eggs for hatching should not be washed, or stored for longer than 10 ten days, preferably seven. Select only hens that are obviously of a good laying type, as judged by late and rapid moulting, absence of fleshiness, etc.

The whole flock must be officially certified free of B.W.D.

Even under ideal conditions, day-old chicks are apt to die if the journey takes longer than 24 hours.

Feed Sacks.

These often become contaminated with infected droppings and may even afford refuge for red mites and tampans and so can be a great danger to other farmers, unless sterilized immediately they are received back by the vendor of the fowl food. The sacks can be rendered harmless by immersion in *boiling* water for ten minutes, and poultry farmers should encourage their feed suppliers to do this.

Feed.

Farmers should consult the excellent bulletin "Poultry Farming in South Africa", written by the late Dr. J. J. Bronkhorst, and obtainable from the Editor of Publications, Department of Agriculture, Pretoria. (Price 1s. prepaid.) Another very useful pamphlet on Nutrition of Poultry, by Prof. Gericke, may also be bought from the Editor of Publications for 6d. Fowls need nothing more than plain, wholesome feed. *Never feed charcoal, spices, bloodmeal or fancy mixtures. Not only are these worthless, but they usually do harm directly or indirectly.*

White maize is just as good as yellow, provided the usual amount of greenfeed is fed—i.e. about 3 to 4 lbs. of greens per 100 adult fowls per day. There is no point in feeding fish oils, if the birds get greenfeed and have access for about half an hour every day to direct sunlight (not sunlight through ordinary window glass). Fish oils, which supply vitamins A and D, are to be incorporated in the mash with discretion,

when long spells of wet and overcast weather are expected, particularly in winter.

Although a ration may contain the amounts of protein, fibre, calcium and phosphorus demanded by law, it does not mean that they are suitable in all other respects, particularly where the vitamins are concerned. Drawing up rations is a matter for experts, and farmers should consult the Colleges of Agriculture when in doubt. Mashes for chicks, ducklings and poults are nearly always intended to be fed *without grain.* Most farmers cannot resist the temptation to feed some grain to these very young birds and as grain is deficient in vitamins like riboflavin and pantothenic acid, deficiency diseases like curled toe paralysis and chick pellagra develop and growth and feathering are impaired. The following table is useful. It was compiled by Almquist, Jukes and Newlon.

Approximate Consumption of Feed by Chickens.

Basis.	Sex.	Age in Weeks.	Pounds per 100 Birds.	
			White Leghorns.	Australorps and Rhode Island Reds.
Cumulative Total to age given	Both sexes	2	28	30
		4	100	105
		6	235	250
		8	410	440
	Females only	10	550	590
		12	730	800
		16	1,190	1,380
		20	1,690	2,020
		24	2,240	2,740
		28	2,820	3,500
		32	3,420	4,250
		36	4,030	5,000
Total, first laying year.........	Female	—	7,670	8,760
Per day, first laying year......	Female	—	21	24

Vaccines.

There are two kinds of fowl pox vaccine and both are sold in bottles of 100 doses costing 2s. 6d. The new and superior kind is for use on fowls and turkeys one to three months old. The old kind produces a less satisfactory immunity, but may be used on fowls and turkeys of any age over a fortnight. The old kind is always sent, if the order does not specify that the new kind is required. Both kinds of pox vaccine may be had from the Officer-in-charge, Veterinary Research Laboratory, P.O. Box 405, Pietermaritzburg, or from the Director of Veterinarv Services, P.O. Onderstepoort. A syringe is unnecessary.

Fowl typhoid vaccine should be employed only on farms that have *not* signed up for the B.W.D. test. Fowls and turkeys over six to eight weeks old are inoculated, and the vaccine may be had from the laboratory, Pietermaritzburg, or from the Director of Veterinary Services, Onderstepoort. Two injections must be given with an interval of a week. The price is five shillings per 100 double doses, and orders may be placed for 10, 25, 50 or 100 double doses. An ordinary 5 c.c. syringe, such as is used for cattle and sheep, may be ordered with the vaccine and the price is 16s. 6d.

Fowl pox and fowl typhoid vaccines may be administered to the same bird on the same day, if necessary.

B.W.D. Test.

Full details of this may be had from the Officer-in-Charge, Veterinary Research Laboratory, P.O. Box 405, Pietermaritzburg. No farm can be regarded as being rid of this devastating infection unless it has been officially certified to be free of reactors. No matter how skilful the breeder is, his stock must be held suspect unless he has the certificate. Always remember that the infection exists on many farms, even though the owners genuinely do not know of its presence. Only the test can reveal carriers of the disease. No wise person buys hatching eggs or chicks or older birds except from clean farms.

All fowls and turkeys over three months old have to be bled for the test at monthly intervals, until the farm has qualified for the B.W.D.-Free certificate. As it is very difficult, if not always impossible, to clean up the infection on a farm where hygienic conditions are poor, the local government veterinary officer has to inspect and approve of the flock and premises before any birds may be bled. So a farmer, desirous of going in for the test, should consult his veterinary officer before doing anything further. The one test fortunately reveals carriers of both B.W.D. and fowl typhoid.

A last word about B.W.D. Some unscrupulous breeders tell prospective buyers of chicks that their flocks have been tested or that they had the certificate. Be careful not to be bluffed by such statements, that are just as misleading as they are true. The great thing is to *make certain that the breeder has the official certificate at the time he sells the birds.* If there is any doubt on this point, the purchaser should consult the laboratory in Pietermaritzburg, or the Secretary of the S.A. Poultry Association, P.O. Box 1795, Johannesburg.

Laboratory Examination of Specimens.

If young chickens are dying, send 4 or 5 dead ones in a cardboard box to the Director of Veterinary Services, P.O. Onderstepoort, or to the Officer-in-Charge, Allerton Laboratory, P.O. Box 405, Pietermaritzburg. Wrap each chicken in a bit of newspaper, but do not use any preservatives.

Dead adult birds may be wrapped, unpreserved, in hessian and railed, carriage paid, to the Director of Veterinary Services, Pretoria North Station, or to the Officer-in-Charge, Allerton Laboratory, Victoria Station, Pietermaritzburg. Live sick birds, properly crated and supplied with food and water, may be railed, *carriage forward,* to the same addresses. A covering letter should accompany each consignment of poultry, giving full details of the symptoms, post mortem appearances, feeding, housing, etc., of the affected birds.

Raising and Maintenance of a Healthy Flock.

Apart from what has been said already, there are a few more very important "dont's" and "do's".

If poultry farming is to be a serious undertaking, do not use hens for hatching eggs, or raising chicks, as these adults are so often carriers of the germs of coccidiosis and roup, and so may spread infection to the young.

It is *absolutely essential* to keep the birds hatched in any one year apart from those hatched in earlier years, and houses and runs must be thoroughly cleaned up and left vacant for a *week* before new fowls are moved in. Double fences, at least 2 feet apart, must separate birds hatched in different years. By observing these precautions and by taking care not to handle younger fowls after older ones, it is possible to eradicate roup germs and lice within a couple of years. Roup germs and lice cannot live away from fowls for more than a few days, hence the stipulated period of one week, and the last of these pests will disappear with the last infected old bird to die or leave the farm.

When starting off as a poultry farmer on vacant premises, begin only with day-old chicks or hatching eggs. In fact, a farmer must never introduce on to his property a live fowl or turkey or duck or goose that is more than one day old, and such chicks and poults must also emanate from plants possessing the B.W.D. certificate. The wise purchcaser will not look at breeding cockerels or pens of breeding hens, no matter how attractive the price may be. If new blood is wanted, buy day-old chicks from a man of repute, who has the B.W.D. certificate, and then select the best pullets and cockerels for the breeding pens the following year. There are weightly reasons for tilting at these established customs. Birds of over a day old, although looking wonderfully fit, may carry the germs of coccidiosis, roup, tuberculosis, cholera, aegyptianellosis and a host of other diseases, besides harbouring a few lice, red mites, scaly-leg parasites and tampan larvae.

The health of the fowls also depends to a great extent on the system on which they are kept. The open-range system is good where the number of fowls does not exceed about three hundred, and where poultry keeping is only a minor source of income on the farm. The battery system is excellent from the point of view of hygiene, but the attendant cost of housing is usually excessive in South Africa. The semi-intensive system, where fowls have access to fenced off ground, is the most popular and at the same time by far the most unhygienic. The reasons for this have been stated clearly above.

The Intensive System.

A poultry farmer, running more than 300 *fowls, should, therefore, stick to the intensive system where the birds, after the age of five months, are kept exclusively on impervious floors.* He will raise the chicks on a clean cement or wooden floor until they are six to eight weeks old, the longer time being necessary in cold weather. Then he will put them out in shelters and allow them to run on soil, in orchards or camps, that has not been utilized for poultry during the preceding year and a half. When the pullets redden up, he will take and lodge them permanently in houses where each has four square feet of floor space and where they cannot come into contact with the soil. The cockerels will fight if crowded in houses and so must be left in clean camps until required for mating.

When a farmer has done all these things, neglecting not a bit of the advice given, his fowls may still die. They are the inevitable losses from cancer and inflamation of the kidneys, and other sporadic conditions that still baffle us, but by harnessing the information we already possess, the mortality figure can be reduced to a minimum. It cannot be expected to achieve more than our scientific knowledge makes possible at any one moment.

The Resting Period of the Dairy Cow.

P. L. Kotzé, College of Agriculture, Glen.

A cow is expected to calve once every 12 months and yield milk for a period of 10 months. Therefore, there are only two months during the year which can be regarded as a resting period. To the farmer, this period of rest between two lactations is one of the most important in the life of a dairy cow. It is very closely connected with her ultimate usefulness and is one of the prerequisites for economical feeding.

Milk production is governed by a number of complicated and closely related functions of the animal body. These functions include digestion and the conversion into milk of food and food constituents which are carried to the udder in the blood-stream and there subjected to the activities of a number of glands. During the lactation period, the digestive system must make use of large quantities of feed (mainly roughage), in order to maintain body condition, the feeding of the unborn calf and the production of milk. The heart must pump large quantities of blood to the udder (approximately 400 lb. for every 1 lb. of milk secreted), the glands are continuously secreting digestive juices, hormones and milk; and the teats are continually exposed to the strain of the weight and pressure of the milk. Consequently the constitution of the producing cow is subject to exhaustion, and to wear and tear of the various body tissues, for 10 months of the year.

When the bodily reserves are used for milk production, fat, sugar, muscular tissues and minerals are consumed. Of these, the latter is the most important. The composition of milk is of such an unvarying nature, that any ingredient in which the feed and body tissues are lacking, becomes a limiting factor in milk production. In this respect, minerals play an important rôle. These nutrients are not only essential as ingredients of milk and all bodily secretions, but also have a stimulating effect on the heart and all the glands which directly and indirectly aid in the secretion of milk. A shortage of minerals in the body can, therefore, have a more limiting effect on milk production than a lack of any other nutrient. In addition, a shortage of lime is always accompanied by the danger of milk-fever, especially in the first stage of lactation when the stimulus for production is high.

With a view to the subsequent lactation, a period of rest of about two months is necessary for the recovery of bodily strength and the building-up of physical reserves. More than 75 per cent. of the unborn calf's total growth in weight takes place during the last 10-12 weeks and consequently the feed requirements of the cow rapidly increase during this period, especially as far as proteins are concerned.

The recovery and growth of udder tissues take place during the dry periods between lactations, and if insufficient feed is provided for the development of the udder during this period, it has a detrimental effect on the cow's milk production during the subsequent lactation.

Unless there is a total recovery of the animal's body, the requirements, as far as feeding and the subsequent lactation are concerned, will be higher and her potential production capacity below normal. Production will, therefore, be uneconomical. Continued neglect of the necessary rest

 [Continued on page 432.

Treatment of Young Fruit Trees.

H. B. Terry, Professional Officer, Division of Horticulture.

DECIDUOUS fruit trees are best planted during the winter months when growth is dormant. In most districts, July is the most suitable time. Fruit trees, after having received good treatment in the nursery, require particular attention from the time they are lifted from the nursery and become established in the orchard.

Every year thousands of young trees are planted out, and great care is bestowed upon them until growth begins; then, in many instances, a period of relaxation on the part of the grower is noticeable. The result is that numerous side-growths and suckers are allowed to grow unchecked, and the head of the tree becomes stunted and lacking in form or design. It cannot be too strongly emphasized that where a well-shaped tree is desired—and this should be the aim of every grower—training must begin during the first growing season. Each tree should be built upon a *single stem*, short and sturdy, to enable it to develop in proportion with the superstructure.

To effect a balance between the roots and top, each tree stem should be cut back at planting time to a height of one's knee, unless several well placed branches have already developed at a convenient height, in which case they should be shortened back to a few buds.

Once a tree begins to grow, care should be exercised to see that at least three well-spaced growths break out around the head of the newly planted tree in order to from the main arms and develop foliage to protect the stem from sunscald. It must be clear that this can only be accomplished by directing the sap into the selected growths, and maintaining vigour by suppressing all other unneccessary growths which develop on the stem, particularly those from below the bud or graft.

With some varieties of apples and pears it will be noticed that only the topmost bud pushes into growth, whilst others remain dormant, and the chances of forming a good head are somewhat doubtful. In such cases it is advisable to pinch back the growing shoot after it has grown a few inches in order to check it. This puts sap pressure on the buds immediately below it, and forces them into activity; should this treatment fail, a small V-shaped notch should be cut just above the desired buds, and growth will result. It is desirable that the points from which these main growths develop are not too close together as weakness would be produced; usually a space of three inches apart will be found suitable.

Where there is any danger of shoots being broken off or blown out by wind, stakes should be provided for their support. It is not too much to say that attention to these details during the early stages of growth determine the success of the commercial orchard.

Having nursed the young trees into growth, no trouble should be spared to maintain and increase their leaf development. The application of water should not be restricted until dependable rains occur. Light rains are deceptive and do not help much, unless an inch or more is collected in the basin around each tree. Some growers, in order to reduce the number of waterings, mulch the soil around the trees with grass, others simply maintain a soil mulch by forking over the soil once every week or fortnight.

Continued on page 422.

Investigations on the Composition of South African Milk.

V. (b) The Ratios of the Percentages of other Constituents to the Percentage Fat in Milk.

S. Bakalor, Dairy Section, Agricultural Research Institute, Pretoria.

THE first section of this article (see *Farming in South Africa,* May, 1948), dealt with the *relationships* between the various constituents of milk, while this section will deal with the *ratios* between the various constituents.

It has already been stated that certain changes occur in the S.N.F. as the fat content of milk increases or decreases. To know that the protein percentage, for example, increases in milk as the fat percentage increases, is, however, insufficient. It is desirable also to know how much of the other constituents is associated with a given weight of fat in milks of varying fat test. For example, if in milk testing 3·0% fat there is, on an average, one pound of protein for every pound of fat, how much protein will be associated with each pound of fat when the fat test is 4·0%? To answer this and similar questions, the change in the *ratios* of the percentages of the other constituents to the percentage fat in milk, as the fat content increases, must be determined. These changes are shown in table VI and fig. V.

TABLE VI.—*The Change in the Ratio, of the Percentage of Other Consituents to the Percentage Fat in Milk, as the Fat Content increases.*

Fat. Percentage.	RATIOS.				
	PRETORIA.				BERGVILLE.
	S.N.F. : Fat.	Ash : Fat.	Protein : Fat.	Lactose : Fat.	S.N.F. : Fat.
2·7	3·04 : 1	0·259 : 1	1·09 : 1	1·69 : 1	—
2·8	3·12 : 1	0·265 : 1	1·10 : 1	1·75 : 1	—
2·9	2·96 : 1	0·251 : 1	1·06 : 1	1·67 : 1	—
3·0	2·90 : 1	0·248 : 1	1·05 : 1	1·61 : 1	2·88 : 1
3·1	2·78 : 1	0·239 : 1	0·99 : 1	1·54 : 1	2·74 : 1
3·2	2·70 : 1	0·232 : 1	0·98 : 1	1·49 : 1	2·64 : 1
3·3	2·60 : 1	0·225 : 1	0·95 : 1	1·43 : 1	2·47 : 1
3·4	2·53 : 1	0·217 : 1	0·93 : 1	1·39 : 1	2·47 : 1
3·5	2·45 : 1	0·209 : 1	0·91 : 1	1·33 : 1	2·42 : 1
3·6	2·39 : 1	0·203 : 1	0·89 : 1	1·30 : 1	2·36 : 1
3·7	2·31 : 1	0·196 : 1	0·87 : 1	1·24 : 1	2·30 : 1
3·8	2·26 : 1	0·195 : 1	0·85 : 1	1·22 : 1	2·25 : 1
3·9	2·20 : 1	0·185 : 1	0·83 : 1	1·19 : 1	2·19 : 1
4·0	2·13 : 1	0·189 : 1	0·81 : 1	1·13 : 1	2·13 : 1
4·1	2·08 : 1	0·180 : 1	0·80 : 1	1·10 : 1	2·10 : 1
4·2	2·04 : 1	0·174 : 1	0·77 : 1	1·09 : 1	2·05 : 1
4·3	2·00 : 1	0·170 : 1	0·76 : 1	1·07 : 1	1·99 : 1
4·4	1·92 : 1	0·156 : 1	0·75 : 1	1·02 : 1	1·95 : 1
4·5	1·93 : 1	0·139 : 1	0·75 : 1	1·03 : 1	1·91 : 1
4·6	1·86 : 1	0·165 : 1	0·72 : 1	0·97 : 1	—
4·7	—	—	—	—	—
4·8	1·74 : 1	0·155 : 1	0·68 : 1	0·91 : 1	—
4·9	1·82 : 1	0·143 : 1	0·70 : 1	0·97 : 1	—
5·0	1·75 : 1	0·140 : 1	0·69 : 1	0·92 : 1	—

As the milk becomes richer in fat, a definite narrowing down of all the ratios occurs, i.e. a decline in the amounts of any of the other constituents associated with a given weight of fat is found. For example, although milk containing 4·0% fat has a higher protein test than milk containing 3·0% fat, the milk richer in fat has only 0·81 pounds of protein for every pound of fat, whereas in the milk poorer in fat, the corresponding weight of protein is 1·05 pounds.

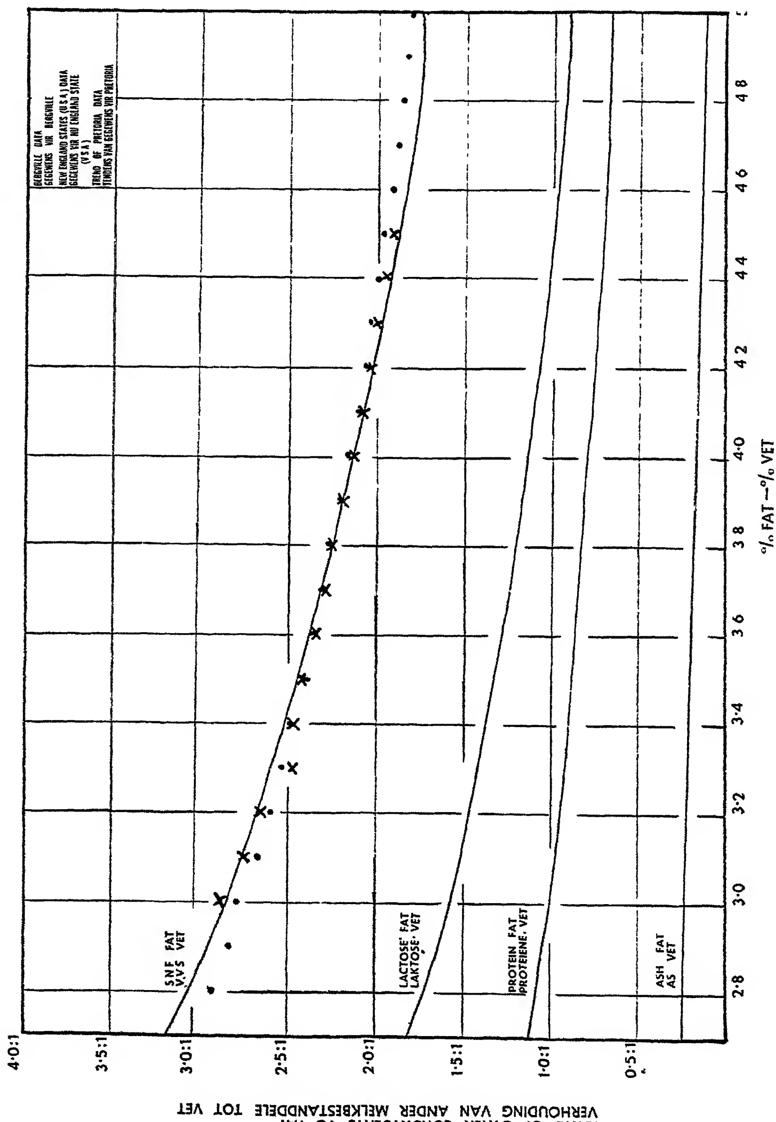

FIGURE 5.—The change in the ratios of the percentages of the other constituents to the percentage fat in milk, as the fat content increases.

In the survey of New England (U.S.A.) milk, a narrowing of the ratio of S.N.F. to fat, with increases in the fat content, was also observed.[7] This is illustrated in fig. V. It is interesting to note how very similar the Pretoria and Bergville milks are as regards the S.N.F.-

fat ratio for the various fat groups, and, indeed, the similarity in trend between the local and the U.S.A. milk. The latter milk appears to be relatively poorer in S.N.F. in the lower fat groups, and relatively richer in S.N.F. in the higher fat groups, than the local supplies.

This particular decrease in the amount of S.N.F. or of the S.N.F. constituents associated with a given amount of fat, is obviously not a phenomenon associated with milk in the Union alone. When ratios, as given in table VI, were calculated for the various fat groups from the Illinois data(8), a narrowing in the ratios of the percentages of other constituents to the percentage fat was found, not only for all the data combined, but also when the milks of individual breeds were considered separately. While the everage amount of protein or S.N.F. associated with one pound of fat in milk testing, say, 3·5% fat may differ from country to country or from breed to breed, it appears that this narrowing of ratios, as the milk becomes richer in fat, is not primarily due to environment, but must be attributed to the basic physiology of the cow.

The monthly variations in the ratios of the other constituents to fat are shown in table VII and fig. VI.

TABLE VII.—*Monthly Variations in the Ratios of the Percentage of Other Constituents to the Percentage Fat.*

	PRETORIA.				BERG-VILLE.	CAPE PENINSULA.
	S.N.F. : Fat.	Ash : Fat.	Protein : Fat.	Lactose : Fat.	S.N.F. : Fat.	S.N.F. : Fat.
October	2·53 : 1	0·221 : 1	0·93 : 1	1·37 : 1	2·38 : 1	2·27 : 1
November	2·65 : 1	0·234 : 1	0·96 : 1	1·46 : 1	2·38 : 1	2·30 : 1
December	2·47 : 1	0·209 : 1	0·93 : 1	1·33 : 1	2·35 : 1	2·26 : 1
January	2·46 : 1	0·200 : 1	0·91 : 1	1·35 : 1	2·30 : 1	2·26 : 1
February	2·46 : 1	0·204 : 1	0·94 : 1	1·32 : 1	2·29 : 1	2·22 : 1
March	2·39 : 1	0·203 : 1	0·89 : 1	1·29 : 1	2·20 : 1	2·17 : 1
April	2·37 : 1	0·197 : 1	0·87 : 1	1·29 : 1	2·14 : 1	2·17 : 1
May	2·36 : 1	0·203 : 1	0·88 : 1	1·28 : 1	2·10 : 1	2·09 : 1
June	2·37 : 1	0·207 : 1	0·88 : 1	1·28 : 1	2·22 : 1	2·13 : 1
July	2·36 : 1	0·209 : 1	0·88 : 1	1·28 : 1	2·27 : 1	2·21 : 1
August	2·52 : 1	0·229 : 1	0·90 : 1	1·40 : 1	2·36 : 1	2·20 : 1
September	2·51 : 1	0·215 : 1	0·90 : 1	1·39 : 1	2·38 : 1	2·25 : 1
Whole Period	2·45 : 1	0·210 : 1	0·91 : 1	1·34 : 1	2·29 : 1	2·21 : 1
No. of years	—	1	—	—	5	15

In all the three areas (including the Cape Winter-rainfall area) a greater concentration of S.N.F. to fat is noted in the spring-summer months, than in the winter period, when milk throughout the country is generally richest in fat.(3) The fact that the Cape Peninsular milk alone is richer in S.N.F. in winter than in summer, had no apparent effect on the monthly variations in the S.N.F.-fat ratio. The monthly variations in fat appear to be the dominant factor. The month-to-month changes in the ratios of ash, protein or lactose to fat are similar to those for the S.N.F. as a whole.

Importance of Ratios to the Industry.

In a previous study it was noted that in milk intended for sweetened condensed milk manufacture, a ratio for S.N.F. to fat of 2·5 to 1, and for unsweetened condensed milk a ratio of 2·25 to 1, was required in order to satisfy legal requirements, etc. As the most popular demand is for sweetened condensed milk, and as the production of unsweetened condensed milk or evaporated milk in the Union during the past four

years never exceeded 5% of the total output of local condenseries, this portion of the report will be mainly related to the manufacture of the former product. The average ratio of S.N.F. to fat in the milk intake of the Union's condenseries over a number of years is 2·39 to 1. The milk received has usually a ratio of less than 2·50 to 1, and the desired ratio has to be obtained by separating off a portion of the fat.(2)

From table V it will be seen that milk reaches an average ratio of S.N.F. to fat of 2·5 to 1 when it tests between 3·4% and 3·5% fat in the case of Pretoria milk, and at Bergville when the fat test is between 3·2% and 3·4%. Above 3·4% or 3·5% fat, the fat is associated of course with a lesser and lesser proportion of S.N.F. At the 3·8% fat level, the ratio of 2·25 to 1 is reached. From the graph it may be noted that the New England milk has an average ratio of 2·50 to 1 when it contains between 3·3 and 3·4% fat, and this ratio falls to 2·25 to 1 when the fat test is between 3·8 and 3·9%. This is not very different to what occurs locally.

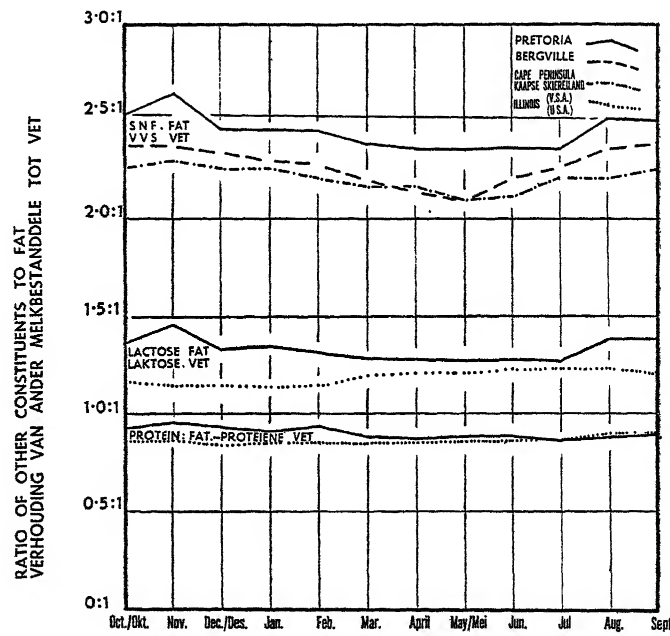

FIGURE 6.—Monthly variations in the ratios of the percentages of other constituents to the percentage fat.

Apparently little or nothing can be done to alter the general principle of a decrease in the amount of S.N.F. associated with a given weight of fat, as the milk becomes richer in this latter constituent. When, however, local milk has a ratio of about 2 to 1 for S.N.F. to fat, as occurs when it tests between 4·0 and 4·2% fat, and between 8·0 and 8·2% S.N.F., something must be at fault with the breeding, feeding or environmental conditions of our commercial dairy stock.

It would obviously be the ideal if the whole milk received by the factories contained the proportions of fat to S.N.F. desired in the resultant product. In practice most condenseries have to separate off large quantities of cream during standardisation. Much of this cream finds its way to the butter industry. As shown in this study, a high fat intake is by no means a guarantee that the S.N.F. intake will also be high.

The purchase of whole milk on a butterfat basis by most local condenseries would appear, at present, to be uneconomic, especially as the surplus butterfat would often have to be resold to creameries at a lower price than its purchase price.*

Cheese Industry.—In a study made at this laboratory on the composition of cheese manufactured at 15 factories throughout the Union, the following averages for this product were found(11):—

PERCENTAGE (DRY BASIS).

	Fat.	*Protein.*
Cheddar	53·435	38·059
Gouda	52·967	37·696

In both cases the average ratio of protein to fat was 0·712 to 1. It is apparent that this ratio must in some way be related to that of the same constituents in the milk from which the cheese was manufactured. In the supplies of Pretoria city producers, the average for this particular ratio was 0·908 to 1. Protein in cheese, however, is derived mainly from the individual protein, viz. casein, which, in turn, accounts for over 83% of the total protein in whole milk. The other milk proteins, albumen and globulin, are mostly eliminated in the whey. No figures are available for the mean casein content of local milk, but from the means given by Davies(6) for large numbers of European and American analyses, it appears that, on an average, 83·63% of the protein of milk consists of casein. Using this figure, it is estimated that the average casein content of Pretoria city milk(1) is about 2·67% (in contrast with a general overseas average of 2·86%.(6) The mean ratio of casein to fat in local milk would be about 0·731 to 1, which is very near the corresponding ratio for cheese. The exact relationship between the composition of milk and that of the resultant cheese, under South African conditions, can, however, only be determined after a long period of experimentation.

City Milk.—Milk which just satisfies the legal requirements for the city trade, i.e. 3% fat and 8·5% S.N.F., has a ratio for S.N.F. to fat of 2·83 to 1. In the case of Pretoria or Bergville milk, the mean ratio at the 3% fat level was 2·90 or 2·88 to 1, i.e. the average here was higher than 8·5% S.N.F. For those fat groups above 3% (e.g. the 3·2% to 3·6% groups in the case of Bergville) the average for S.N.F. was less than 8·5%, and thus the ratio here was narrower than 2·83 to 1.

From the investigation of the supplies of city producers(1), it was noted that partially-skimmed milk was abnormally high in S.N.F. or protein, in relation to the fat it contains. The data in table V prove that heard milk which conforms to the standard for fat (3·0%) should never have a ratio of S.N.F. to fat of more than 2·90 to 1, or a ratio of protein to fat of more than 1·05 to 1. This can be confirmed from the data of overseas studies.(7)(8) The following ratios were determined for the partially-skimmed supplies of one city producer:—

RATIOS.

S.N.F. : *Fat.*	*Protein* : *Fat.*
3·13 : 1	1·17 : 1
2·71 : 1	1·08 : 1
3·70 : 1	1·34 : 1
2·97 : 1	1·11 : 1
3·26 : 1	1·23 : 1

Range fat	2·6 per cent. to 3·2 per cent.
Protein	3·44 per cent. to 3·55 per cent.
S.N.F.	9·14 per cent. to 9·63 per cent.

* The price of first grade butterfat purchased by creameries is 2s. 5d. per lb. If milk supplied to condenseries is bought on a butterfat basis, a price of 3s. 0¾d. per lb. has to be paid. (Dairy Control Board Circular No. 30/47 of 29th October 1947).

In detecting partially-skimmed supplies, the milk should be analysed for fat, protein and S.N.F., and the respective ratios should be calculated in order to determine whether the concentration of other constituents to fat is abnormally high.

Composition of Fat Free Milk.

This investigation cannot be completed without considering the influence of the fat content of the original whole milk on the composition of fat-free milk (i.e. skim-milk from which all the fat has been removed). The effect of this original fat content on the composition of the fat-free separated milk can be seen in the following example:—

Whole Milk.		Fat-free Skim-Milk.
S.N.F.	*Fat.*	*S.N.F.*
Per Cent.	Per Cent.	Per Cent.
8·50	3·0	8·76
8·50	4·0	8·85

Thus, if the S.N.F. content of whole milk remains constant, but the fat content increases, there will be a greater concentration of S.N.F. in the skim-milk derived from the milk richer in fat.

As the whole milk becomes richer in fat, the changes in solids content of the resultant fat-free milk are similar to those occurring in the milk from which it was derived (see table I) except in the case of lactose. In whole milk this constituent tends to decrease as fat increases. In the corresponding skim milks this decreasing amount of lactose from the original whole milk, is concentrated in a lesser and lesser proportion of the skim-milk as a whole. For example, if the original milk tested 5·0% fat and 4·6% lactose, there would be 4·6 parts of lactose in 95 parts of skim-milk. The changes in the lactose content of this fat-free milk are thus found to be irregular.

Summary and Conclusions.

(1) In South African milk, produced in the summer-rainfall area, no relationship was found between the S.N.F. and fat contents, or between the ash and fat contents, when the results of individual tests made throughout the year were considered. A definite positive relationship was, however, found between the annual means for fat and S.N.F. in the Estcourt and Franklin areas over a long period.

(2) Local milk tends to become richer in protein and poorer in lactose, as the fat content increases. The total solids content follows a trend similar to that of fat. As the S.N.F. as a whole increases, the ash, protein and lactose content also tend to increase.

(3) No relationship was found between S.N.F. deficiency and fat content. Many samples with high fat tests had very low tests for S.N.F. The milk became less deficient in protein, however, as the fat content increased.

(4) The amount of S.N.F., or of any of the S.N.F. constituents, in milk of a particular fat content varied from month to month. The apparent lack of relationship between S.N.F. and fat in individual tests can be attributed largely to the differences in seasonal trend of the various constituents of milk

(5) Mastitis and similar udder disorders cause an increase in the chloride content of milk. This may have obscured any possible relationship between the ash and fat contents of milk. Skimming tends to increase the average amount of S.N.F. or protein in commercial milk of low fat test.

(6) As milk becomes richer in fat, a definate narrowing down of the ratios of the percentages of the other constituents to the percentage fat occurs, i.e. there is a progressive decline in the amounts of the other (S.N.F.) constituents associated with a given weight of fat. This narrowing down in ratio is not merely characteristic of local milk, but is also found in the commercial milk of other countries and in the milk of individual breeds.

(7) In various areas of the Union (including the Cape Winter-rainfall area) a greater concentration of S.N.F. to fat is noted in the spring-summer months than in the winter, when the milk throughout the country is generally richest in fat.

(8) The importance to the industry, of variations in the ratios of the S.N.F. constituents to fat is indicated.

(9) The composition of fat-free milk is shown to be directly influenced by the fat content of the whole milk from which it is derived.

(10) In the Union's dairy industry, the main interest appears to be in the fat or butter-fat content of milk. The S.N.F. content of milk is largely ignored. It is true that our butter industry is dependent on high fat yields, but the other sections of the dairy industry, such as cheese-making, condensing or even city milk, are just as dependent on the solids content of milk as a whole. In a product containing about 88% water, it is not enough to concentrate on the 3·5% or so, of fat, and to ignore the other solids. The relationship between the general level of S.N.F. and fat in an area over long periods, and the intimate connection shown between the protein and fat, prove that, if the S.N.F. content of milk is neglected, an inevitable lowering in fat must occur. A shifting of the emphasis from the fat to the solids content of milk as a whole is thus urgently required.

Acknowledgments are due to:—

(i) The Dairy Industry Control Board for providing the funds necessary for this investigation.

(ii) Messrs. Union Milk Products, Ltd., and Messrs. Nestlè (S.A.) Ltd. for data on the composition of their milk supplies.

(iii) Messrs. Pretoria United Dairies (Pty.) Ltd., at whose plant the milk supplies of city producers were sampled.

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Treatment of Young Fruit Trees:—

[Continued from page 414.

The stems of trees may be protected from sun, wind and hares by wrapping paper around the stems; when the paper is removed the stems should be whitewashed as a protection against sunscald. Remove all nurserymen's labels to prevent the string or wire cutting into the bark and later wrecking the labelled tree.

As growth advances a careful watch should be kept for aphis, leaf-eating beetles, leaf-rollers, or any disease symptoms, and prompt action taken by applying suitable sprays to control the infestation. Anything that restricts the production of leaves on young trees is a menace to growth and must be controlled. These remarks are made because many people believe that there is no need to buy a spray pump immediately after planting—there being no fruit to spray. A supply of arsenate of lead should be on hand for use against chewing insects, also some insecticide, such as tobacco extract, or nicotine sulphate to combat aphids, and Bordeaux powder or lime sulphur for fungoid diseases. Further advice may be obtained from the nearest College of Agriculture, or the Chief, Division of Horticulture, P.O. Box 994, Pretoria.

Useful Bulletins.

The following are a few of the bulletins obtainable from the Editor of Publications, Department of Agriculture, Pretoria, post free and prepaid at the prices indicated:—

Poultry Farming.—Bulletin No. 241, by Dr. J. J. Bronkhorst. Price 1s.

Poultry Houses.—Bulletin No. 257, by C. L. Marais and N. J. van Straaten. Price 1s.

Turkeys.—Bulletin No. 264, by E. F. Lombard and Prof. A. M. Geriche. Price 3d.

Classing of Poultry or the Culling of Non-Producers.—Bulletin No. 207, by P. J. Serfontein. Price 3d.

The Small Hive Beetle.—Bulletin No. 220, by Dr. H. E. Lundie. Price 3d.

Is it Profitable to Lime?

J. G. Brevis, Lecturer in Chemistry, College of Agriculture, Cedara.

THE useful effect of lime on sour soils was well known to the ancient agriculturists. Together with manure it was always the main item in maintaining the fertility of the land, until the advent of artificial fertilizers towards the latter half of the 19th century. To-day lime still holds a prominent place in the agriculture of Great Britain and Europe, where lands were limed and cropped for many centuries.

It is strange, therefore, that many farmers in our sourveld areas regard the application of lime with prejudice and seem to think that lime impoverishes the soil. Enquiries usually reveal that ignorance of the correct use of lime may have been responsible for this wrong conception. Liming can be profitable, provided it is done judiciously. In the hands of the inexperienced it is fraught with danger. A dificiency of lime in a soil is mostly the cause of sourness. The degree of acidity is expressed by the term pH. A pH between 6·5 and 7·5 denotes more or less sweet conditions. As the pH moves from 6·5 to 3·0 it denotes an increased acidity, and a pH from 7·5 to 8·5 denotes increased alkalinity or brak conditions.

The function of lime on a soil is:—

(1) To counteract excessive sour conditions, which may be the major cause of unproductiveness in many soils of the high-rainfall areas.

(2) To stimulate the soil bacteria, so that they may perform their duties in rendering the insoluble plantfoods available and also promoting nitrification, thus also changing the soil nitrogen into the available nitrate form.

(3) To improve the physical condition of the soil by changing a compact and clayey soil so as to have an open and crumbly condition.

(4) To supply the soil with the plantfood lime, which certain plants, like legumes, require in larger amounts than other plants. It is therefore essential for farmers in the high rainfall or sour areas, where the soils are deficient in lime due to excessive leaching, to adopt a sound liming policy.

This should be based on the following points:—

(1) Whether lime is necessary.

(2) What kind of lime to use.

(3) How much to apply per acre.

(4) When and to which crops it should be given.

To answer the first point, a farmer should know whether his soils are sour and to what degree, as this influences the lime requirement of the soil. It will be necessary therefore to have the soils analysed for acidity. Once the need of lime is established, the question arises, which of the three types on the market should be used, namely:—

(1) *Agricultural lime,* i.e. carbonate of lime ($CaCO_3$). This is either the natural limestone rock, shells or fossilized marine deposits, pulverised, and marketed as agricultural lime. The colour varies from white to a dirty grey powder. The beneficial effect on the soil often only shows up after a season or two. This form is the safest to use by the inexperienced farmer.

(2) *Quicklime or " burnt lime ",* i.e. the oxide of lime (CaO). When limestone is burnt in kilns a gas escapes and the quicklime is left behind as white porous lumps.

(3) *Slaked lime or hydrated lime,* i.e. $Ca(OH)_2$. When water is added to quicklime, it heats and swells up, crumbling into a white powder called slaked lime. When quicklime is exposed, it absorbs moisture from the atmosphere, becoming slaked, and if left exposed for some weeks reverts back to the mild carbonate form.

The latter two types of lime are very quick-acting, but unfortunately very drastic on the soil organic matter, and should therefore not be used on humus deficient or sandy soils. They should be applied to the compact clayey type of soils, as the farmer will rather sacrifice some soil humus for better structure and productiveness in this type of soil. Quicklime should be slaked before applying to the soil, otherwise it may tend to form lumps, espicialy, if the soil is fairly moist. Agricultural lime is always recommended to sweeten sour soils, and quicklime and slaked lime should be used for this purpose only in exceptional cases, and then they must be applied only in small dressings. They are generally used for improving the crumb structure of compact soils. It is of interest to note that 100 lb. of agricultural lime is equivalent to 74 lb. slaked or 56 lb. quicklime. The question now arises how much lime should be applied. This depends on:—

(*a*) *Soil texture,* as the amount will vary, according to whether it is a sandy or clayey soil. Less lime is required to sweeten a sandy soil than to neutralize a clay soil of the same acidity.

(*b*) *Degree of acidity.* The greater the acidity, the larger will be the amount of lime required to sweeten it. About 800 lb. per per acre of agricultural lime is usually applied to sour sandy soils, increasing the quantity up to 2 tons per acre for heavy clay soils.

Too heavy applications of lime may cause temporary unproductiveness, or the injury may last for longer periods and is usually noticed by the yellowing of the leaves. Overliming should therefore be guarded against, because if the pH of a soil is raised above 6·5, there is a possibility that certain trace elements such as manganese, boron, etc. may become unavailable, and this will then cause deficiency diseases in plants, due to lack of these. The lime is usually broadcast on ploughed lands and then harrowed in. The correct time of application is not always easy to fit in with the cropping system. It is usually broadcasted and harrowed in a few months before planting, if possible in midwinter, so that the soil many be ready for the spring crops. It is also a good practice to apply it before planting crops susceptible to sour conditions, e.g. legumes. These also require about five times more lime than other crops as nutrient, and will therefore drain heavily the already lime deficient soils, thus impoverishing them more and more. Many people imagine that lime can take the place of fertilizers. This wrong assumption is due to the fact that the influence of lime on the soil is to make available those plantfoods, which are insoluble under sour conditions. This effect of lime in releasing insoluble plantfood, will in the long run exhaust the soil of these nutrients, proving the age old adage "Lime and lime without manure make both land and farmer poor." To lime, however, is both a sound and profitable practice, provded the land is properly fertilized so as to maintain these reserve plant-nutrients in the soil.

The Cochineal and its Control in Spineless Cactus Plantations.*

Dr. F. W. Pettey, Principal Entomologist, Uitenhage.

THE cochineal, *Dactylopius opuntiae,* was imported from Australia in 1937, when it appeared probable that *Cactoblastis cactorum* would not attain the degree of success in the control of our common pest prickly pear, *Opuntia megacantha,* hoped for. The importation consisted of a case containing a few infested *Opuntia* branches. The insect thrived and increased rapidly at Uitenhage on our pest pear, and in about 2 years there was sufficient material to start general distribution on pear infested properties. A staff of approximately 30 men with 9 lorries was engaged in distribution work from 1940 to the middle of 1944, when distribution was completed throughout all infested areas of the eastern Cape Province, and the insect was established on all pear-infested properties. It has been distributed also in other parts of the Union where prickly pear has so increased as to become a menace.

Success Attained by the Cochineal.

This insect has exceeded all expectations in the destruction of prickly pear. With a few exceptions, in a year or 18 months after it had been established in the veld in a locality, it had not only spread over a wide area, but had greatly defoliated the large plants, and killed most small ones. In the inland areas, i.e. about 40 miles from the coast, its intensity of attack has been greatest and most persistent. The greatest destruction of the pear has occurred in all karoo areas (except the coldest side of the higher slopes of mountains), and in those usually dry inland non-karoo areas, hot in summer, where the soil is deep and fertile and the pear is succulent, as for example in the vicinity of Cookhouse. Here many large as well as most small plants were eradicated, and the remainder were so defoliated that only stumps of the larger standing plants survived. It has almost completely eradicated the prickly pear in the Oudtshoorn, Calitzdorp, and Ladismith Divisions, leaving only very scattered and damaged remnants of standing plants. It was aided there by the prolonged intense drought of 1942. The insect thrives best in dry conditions. In most inland areas it has periodically and persistently defoliated the large plants, preventing them from bearing much fruit, and has killed most seedlings as they appeared, and it has completely killed many large standing plants. The insect has, however, accomplished the least destruction of standing pear in the coastal areas, where the summer temperature is too low to enable it to increase rapidly and out-breed its ladybird beetle enemy predators, in limited non-karoo areas where *Empusa* has become established and in the limited colder situations of the high mountain slopes of the karoo least exposed to the sun in winter.

This cochineal, assisted in its work by the felling of the surviving standing plants which it has previously defoliated, has to date practically cleared of prickly pears about 700,000 morgen of veld in the eastern Cape Province, which was more or less heavily infested leaving only about 6 per cent. of the acreage originally infested to be dealt with. Most of the surviving prickly pear is in a belt within 50 miles of the sea coast. The clearing of the 700,000 morgen of agricultural lands of this weed

* A resume of a bulletin to appear later.

has been accomplished at an estimated cost to the tax payer of between £140,000 and £200,000. A considervative estimate of the cost that would have been necessary to have cleared this acreage of pear by poisoning would be £10,000,000, not including the expenditure involved in losses of stock from poisoning.

How the Insect Spreads.

Cochineal insects may be carried far and wide by means of larger animals ranging in size from beetles and birds to baboons and cattle. The young larvae may crawl on to the feet of birds and the bodies of larger insects, even ladybird beetles, as they rest or move on infested cactus plants or upon parts of stock and other animals as they come in contact with them, and so be carried to other pear plants or spineless cactus. The young larvae may even be transported some distance by strong winds and air currents. These factors have resulted in the gradual spread of cochineal to most spineless cactus plantations throughout the karoo, miles distant from the nearest prickly pear on which the insect was placed, being aided by very scattered host plants, i.e. prickly pear or a few spinless cactus plants in gardens, occuring at intervals of a few miles or less in that area, which have served as connecting " bridges ". The enormous power or reproduction possessed by the females is an important factor in their ability to spread.

Cochineal Damage to Spineless Cactus.

Unfortunately, the cochineal also thrives on and causes serious damage to all spineless cactus varieties cultivated for fodder in South Africa, except in the case of the round, bluish-green thick leaved varieties, some of which are commercially grown in the colder parts of the karoo which do not tolerate other varieties.

This cochineal has spread or is spreading to almost all spineless cactus plantations in the country, and it has appeared in widely separated areas throughout the Union. If it is left undisturbed in a plantation it will spread fairly rapidly, causing considerable injury to the plants of all susceptible varieties, and particularly in semi-arid or drought conditions it will destroy completely many plants, especially young ones and those weakened by the grazing of stock on them. The neglected, scattered and isolated plants or small clusters of prickly pear occurring in the spineless-cactus plantation areas of the central and the northern Cape Province, the Orange Free State and the Transvaal, if they are not destroyed as soon as the cochineal appears on them, will serve as bridges to facilitate and hasten the spread of the infestation to spineless cactus plantations. Such infested plantations, where control of the insect is neglected, also serve as serious sources of infestation for other plantations in their vicinity.

Cochineal Easily Detected.

When cochineal reaches a cactus plantation, it will arrive there generally in small numbers, unless the plantation is in the vicinity of an extensive area of prickly pear or of spineless cactus which is heavily infested. The insects usually appear first on only one or a very few leaf pads of a single spineless cactus plant or on only a few plants widely separated in a plantation. They are very conspicuous and are easily detected. They are evidently in the form of small, irregular clumps of white cotton-like masses, each of which consists of a few numbers of insects. These masses increase in size and number, and the progeny of the females increase and spread fairly rapidly to other plants if they are left undisturbed.

Prompt Measures to Eradicate Cochineal in a Plantation Urged.

An effective D.D.T. spray for the destruction of cochineal has been found by the writer in recent investigations carried out at the Grootfontein College of Agriculture, but it is practical to make use of it only in the early stages of infestation in a plantation, when comparatively few plants have become infested, because of the expense involved.

It is therefore emphasized that it is highly desirable for the owner to have his plantation carefully inspected monthly throughout each summer, and occasionally during each winter, in order to deal promptly with the few infestations as they appear.

If the insect's presence is detected while it has infested only a few leaf pads or plant segments of a very few scattered cactus plants, these insect clusters may be eradicated by crushing them with one's finger, repeating this measure of control when the few new infestations are found. Thorough inspection of all plants in a plantation should be made regularly and the infestations be disposed of by this method to keep the insect under control in such conditions. It is, however, only practical when the source of infestation is a small one, where stock is not allowed to graze on the cactus plants, and only when the infestation is in its initial stages.

There is need of co-operation and concerted action among spineless cactus growers of a district in measures to control the spread of cochineal. Neglect in the control of cochineal in one plantation will result in further spread of the insect to others in the vicinity. Neglected infested plantations or neglected scattered infested prickly pear will be a source of possible widespread infestations in other plantations of the district. Scattered prickly pear should be eradicated.

Control of Cochineal by Spraying.

(1) *Tests with Triton D.D.T. Emulsion.*—Investigations to determine if it would be practical to control or eradicate cochineal on fairly heavily infested spineless cactus plants were carried out at the Grootfontein College of Agriculture in a small plantation of *Opuntia fusicaulis* in the spring and summer of 1946-47.

The results of these tests indicate that even when spineless cactus plants are fairly heavily infested with the insects, two applications of a Triton emulsion so diluted as to contain .1 per cent. actual D.D.T., the first spray applied about the 20th of October, or as soon as an appreciable number of larvae appear on the leaf pads of infested plants, and the second applied 5 to 6 weeks later through a disc-type spray nozzle at a pressure of at least 75 lb., will get and keep cochineal well under control, if the sprays are thoroughly and copiously applied. The number of spray applications which will be necessary will depend to a great extent on the amount of pressure that is maintained by the spray pump used. If a handbucket-pump, from which only a very low pressure can be obtained, is used, very probably at least three applications would be necessary to obtain satisfactory control the first season of treatment, and if a power pump is available which would maintain a pressure of 150 to 200 lb., possibly only one spray application would produce satisfactory control.

It is unlikely that cochineal can be completely eradicated by such a spray program when once the insect has become well established in a plantation, but it can be so reduced in numbers that it will cause little or no injury to the plants and it can be thus prevented from spreading to other plants.

The degree of infestation on the cactus plants each summer, following this spray treatment, would determine the number of spray applications necessary then, and whether or not a similar programme would have to be carried out. If the infestation is very light, possibly only one spraying would be necessary, providing that it is done at reasonably high pressure.

(2) *Test with D.D.T. in the form of a wettable powder.*—At Uitenhage in the summer of 1947, tests were made with a wettable powder so diluted as to contain 1 per cent. actual D.D.T. The sprays were applied by means of a bucket pump with disc nozzle at intervals of about 2 weeks between each application, from December 30th to April 10th, on five spineless cactus plants well infested with cochineal. Counts of surviving larvae found on heavily infested leaf pads, selected one on each of the five separate plants, were made just before each spray was applied. These leaf pads were marked and the data was obtained from these same pads throughout the spray period. The observations and results show that D.D.T. applied in this form does not penetrate the waxy covering of the more mature insects and kills only the larvae or crawlers. Surviving larvae and some living mature females were still present on the leaf pads after the 8th spray was applied, and 3½ months after the first spray treatment.

It is concluded, therefore, that D.D.T. in this form is unsatisfactory for the control of cochineal. It is possible, however, that somewhat better results may have been obtained with such material if a spray pump had been used from which a high pressure of 150 lb. to 200 lb. could have been obtained.

Because of the high cost of material and the labour required to apply it, it is useless to attempt control of this insect by spraying after the infestation of a plantation has become wide spread or extensive.

(3) *Control of Cochineal by Use of its Natural Enemies.*—The fungus, *Empusa lecanii*, which now causes seasonal considerable depletions of cochineal in many areas within about 60 miles of the sea coast, does not thrive in the karoo and is therefore useless for the control of cochineal in the main spineless areas of the Union where most spineless cactus is cultivated.

Although the ladybird beetles, *Cryptolaemus montrouzieri* and *Exochomus flavipes* attack and feed on the cochineal insects, they do not increase rapidly enough on cochineal-infested spineless cactus under karoo conditions to warrant their use for keeping the cochineal under control. Experiments conducted in a spineless cactus plantation heavily infested with cochineal in the Aberdeen district in 1945 proved that, even when a million of these ladybird beetles were placed in a plantation of a morgen spineless cactus, the cochineal population was not perceptibly reduced.

State of Present Spineless Cactus Plantations with Relation to Control of Cochineal by Spraying.

Practically all the spineless cactus plantations, except in the high colder parts of the karoo, comprise only varieties of cactus which are susceptile to serious injury by cochineal. With few exceptions the plantations in the more inland districts from Hofmeyr and Middelburg and Murraysburg districts southwards have now become so extensively and heavily infested with the cochineal as to make control of this insect by spraying impractical because of the extremely high cost involved. In such cases the infestation will simply have to be allowed to take its course. There are still plantations of susceptible varieties in the districts of

Hofmeyer, Middelburg, Steynsburg and further inland sufficiently distant from extensively infested areas where the infestation is still sufficiently limited or non-existent to make control by spraying practical. Prompt protective measures by spray treatment in summer with Triton liquid D.D.T. should be taken as soon as the infestation is detected and before it spreads widely. Monthly inspection during the warm months of the year should be made to detect the insect soon after it appears.

In the districts of Bedford, Adelaide, southeren Somerset East, and other areas within about 60 miles of the sea coast, cochineal does not thrive sufficiently to destroy plantations of susceptible varieties, because of its natural enemies, although some leaf pads are killed. In such areas spray treatment is not recommended, but owners of such plantations are advised not to allow stock to graze so freely on the cactus plants as to leave only stumps. Close grazing of catus plants so weakens them that many cannot survive even a light infestation by cochineal.

Present common methods of close planting of susceptible varieties of cactus, in rows narrowly spaced, and either grazing cattle on the crop or allowing the plants to fruit, and the practice of maintaining huge plantations of 50 to several hundred morgen in the veld, uncultivated will have to be abandoned and such plantations will possibly have to be eradicated, together with all prickly pear in inland districts, before it will be practical to keep this insect under control by spraying in smaller plantations. Most present plantations comprise spineless varieties which are unsuitable for succesful control of cochineal by spraying because of the low spreading habit of growth and which bear fruit abundantly. The variety *O. fusicaulis* has an upright growth, does not bear fruit freely and has well-spaced branches. This is a most suitable variety for cultivating when there is danger from cochineal attack.

Future Spineless Cactus Plantations and the Problem of Control of Cochineal.

Based on observations made to date, the following instructions should be carried out in the future, if control of cochineal in a plantation of a spineless cactus variety susceptible to serious damage by this insect is to be practical in inland areas:—

(1) The district where the plantation is to be established must be cleared of all prickly pear and infested or neglected spineless plantations in order to avoid extensive sources of infestation by the insect.

(2) Plantations should be limited in size to a maximum of, say 5 morgen or no larger than to permit easy regular monthly inspection for detecting the insect as soon as it appears.

(3) The plantation should be cultivated and should be established in fertile deep soil to maintain vigorous growth and produce a maximum forage crop of leaf pads to serve as feed for farm animals.

(4) The plantations should be fenced to prevent stock from grazing on the plants. Moderate or haphazard grazing of stock on the cactus plants should be avoided, as such practice cause waste of leaf pads, results in accumulation of refuse among and under the plant branches, and promotes a dense growth, making penetration by spray, to cover all cochineal in case of infestation, impossible, and causes a low branching habit which hinders thorough spray treatment.

(5) The leaf pads should be harvested for feeding, breaking them off at the joints.

(6) The plants of a plantation should not be allowed to fruit. Experience shows that spraying will not control cochineal on fruit, because of its convex nature, which prevents exposure of the insect to the full pressure of the spray as it is applied. Furthermore, fruit is undesirable as a stock feed if it bears numerous spicules.

(7) The plantation should comprise only varieties which have an upright and open habit of growth, such as *O. fusicaulis* and not be of a low spreading nature, to facilitate thorough coverage by a spray in case of infestation.

(8) The rows of a plantation should be so spaced as to allow access of a animal-drawn high-powered petrol spray-pump in case treatment is required when the plantation becomes infested with cochineal. The plants of each row should be sufficiently spaced to allow vigorous growth and access of the spray to all parts of the plants. Wide spacing of rows would also be of advantage to facilitate loading of leaf pads and haulage by a vehicle when the pads are harvested.

(9) Leaf pads should be harvested periodically to serve as stock feed and to prevent the branches from attaining a height of more than about 6 feet, to facilitate thorough spraying and prompt detection of the insect when it appears, and to prevent fruiting.

(10) Every year the plantation should be thoroughly inspected monthly, from October to June, to detect cochineal soon after it appears.

(11) As soon as cochineal appears on a plant or plants the infested leaf pads should be either removed and fed to stock or, if practical, the infestations should be removed by hand crushing. If the infestations are too numerous to be dealt with in this manner, the infested plants should be sprayed promptly and thoroughly, preferably at a pressure of no less than 100 lb., with Triton liquid D.D.T., so diluted with water as to contain at least 1 per cent. actual D.D.T., followed by another application of this strength in a month or six weeks following the first, if living insects are still present, and be repeated again after another such interval if necessary. Preceding the spray applications, all fallen leaf pads, decayed or green, should be removed from among and around the plants to be treated, and these should be fed to stock or be destroyed by burning. All fruit from such plants should be removed and be disposed of previous to spray treatment of the latter.

(12) An alternative to instructions numbered 4, 5, and 9, is the following which is favoured by Grootfontein officials: Grazing without any wastage can be accomplished if plantations are divided into small plots by fencing and if these small plots are grazed heavily biennially. Heavy grazing results in the consumption of all leaf pads, and only the more woody, fibrous stumps are left. Pads that are broken off by the animals are usually cleaned up from the ground if intensive grazing is practised. Experience with this method can only determine whether or not prompt detection of cochineal infestation could be effected, and whether or not infestations by the insect of the rough fibrous surfaces of the chewed off stumps could be

effectively reached and penetrated by spraying. For further particulars concerning this grazing method, in small paddocks, the cost involved for fencing, and the number of paddocks necessary to serve the size of herd or flock of animals concerned and other relative information Grootfontein authorities should be consulted.

Varieties Susceptible and Not Susceptible to Cochineal.

Susceptible Varieties.—All the spineless cactus varieties most palatable to stock, the terminal "leaf pads" of which range from oval or elliptical to lanceolate are susceptible to serious injury by the cochineal insect. In tests at Graaff-Reinet, conducted by J. S. Taylor and the writer in 1943, the following varieties were ultimately killed by the cochineal: Fusicaulis, Protektoraat, Arbiter, Ficus-indica, Skinners Court, Meyers, Sicillian Fig and Gymnocarpa. All varieties of these types of leaf pads cultivated in plantations are susceptible to serious injury by cochineal in the dry inland areas where this insect flourishes.

Varieties which tolerate Cochineal.—These include the four round dark or bluish green, thick-leaved varieties found in South Africa. They are Monterey, Robusta, Nudosa and Chico. They are similar in the following respects: Their leaf pads are large, circular, thick and bluish green. They are equally less palatable as a stock feed than the oval to lanceolate-leaved varieties which are susceptible to injury from the attack by cochineal. In grazing experiments at Grootfontein, when stock has access to both the round leaved and the oval to lanceolate-leafed varieties, they devoured the latter and refused the circular leaved group. Farmers, however, who have plantations of the round-leaved varieties exclusively, maintain that they have had excellent results from grazing their stock on them. In feeding trials at Grootfontein where leaf pads were cut, it was found that sheep would take less of a circular leaved variety than of Fusicaulis. In spite of this the animals seemed to thrive equally well on both sorts. This may possibly be explained by the observation that animals feeding on the circular leaved varieties are less susceptible to purging than those feeding on the more palatable. The fruit of all circular leaved varieties bears spicules and spines. The leaf pads of these four varieties bears spicules, and, with the exception of *Robusta,* spines. Chico and Nudosa bear more spines usually than Monterey, and their spines occur on any part of a leaf pad. Monterey bears its spines mostly along the margines of the pads. Chico has less rounded terminal leaf pads and they are greyish green in colour. Although the circular leaved are lower yielding than some of the best more palatable spineless sorts, they compare fairly favourably with such varieties as Fusicaulis in respect to yield. Although no survey has been made, probably Monterey and possibly Robusta are the circular leaved varieties most commonly cultivated in plantations of the upper karoo areas where the climate is too cold in winter to make the growing of the more palatable or susceptible varieties possible. Chico, according to Mr. W. Rubidge, is not favoured. Robusta, because of the total absence of spines on the leaf pads, would appear to be the most desirable of the four varieties.

The four circular leaved varieties tolerate cochineal, and they serve as hosts for the insects, although they are not injured appreciably. Sufficient numbers of the insects are able to subsist on these varieties to result in an infested plantation being a serious source of infestation for susceptible varieties of spineless cactus if the latter should be established in the vicinity or even in a district where a circular leaved variety is grown.

The Resting Period of the Dairy Cow:—

[Continued from page 413.

period will lead to a serious weakening of the cow's constitution, which will in turn lower her resistance to disease and other unfavourable conditions, and shorten her life.

The feed requirements of a cow during this resting period are determined by the condition of her constitution when she is dry. Sufficient good, protein roughage is most important during this period. One of the best sources of protein-rich feed is green pasturage or green feed, but if this is not available, 1 part by weight of good legume hay and 2 to 3 parts of silage (especially maize silage) make and excellent substitute. In the case of high-producing dairy cows, it is desirable to supplement the roughage with a small daily ration of protein concentrates. This type of feed usually provides the resting cow with all the necessary minerals, proteins and vitamins for her recovery. Dry pasturage alone, is never sufficient.

During the last months of pregnancy, the cow's condition should improve rapidly. Every effort must be made to keep the cow from becoming constipated; this can be achieved by giving sufficient succulent feed, especially when the vulva begins to relax immediately before the calf is born. A good rest will save feeding costs during the subsequent lactation.

The resting period can be ensured only by adopting a system of controlled breeding. Normally a cow comes on heat within a month after calving. If the bull has free access to a cow at this time, the latter may come into milk within 10 months after bearing the previous calf, which means that there will be no resting period between the lactations. A cow with a lactation period of 10 months' duration should, therefore, not be served before she has been in milk for almost three months.

Poultry Farming.

Bulletin No. 241. *Poultry Farming in S.A.* which was out of stock, has been reprinted and is again obtainable from the Editor of Publications, Pretoria.

(Price 1s. per copy, post free.)

Nursery Quarantines.

The following nurserymen were in quarantine as at 1st June, 1948 :—

(1) Montana Nurseries, Farm Alkmaar, P.O. Nelspruit, on citrus (all) for red scale.

(2) Mooiuitsig-Kwekery, Boschrand, Private Bag, Nelspruit, on citrus (part) for red scale.

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VOLUME XXII.—JANUARY, 1947 TO DECEMBER, 1947.

[*The asterisk (*) denotes that the articles are illustrated.*]

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ANNUAL REPORT FOR THE YEAR ENDED 31 AUGUST, 1947.

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Articles marked with an asterisk (*) are those referred to in the Editorial.

[*Photo on Cover :* Charming Homestead in the Cape.]

[NOTE.—Articles from *Farming in South Africa* may be published provided acknowledgment of source is given.]

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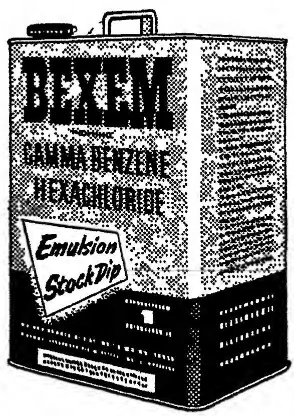

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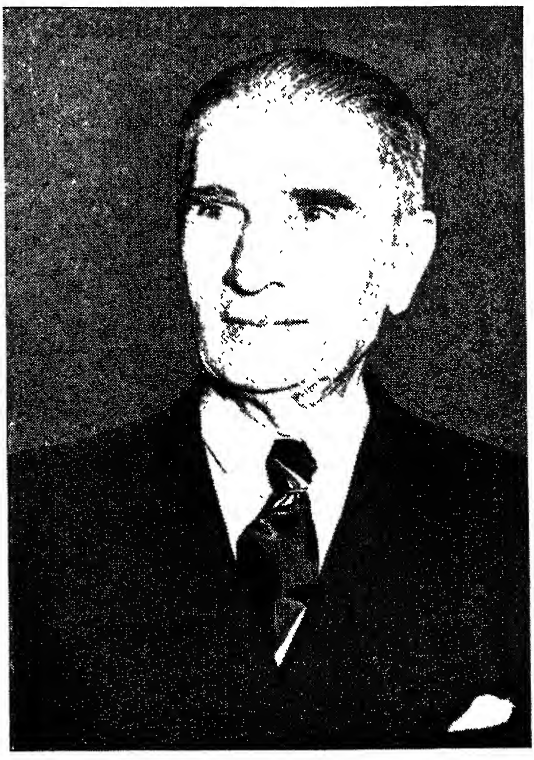
P.O. NORTH RAND – – TRANSVAAL

A Message to Farmers.

By the Honourable Minister S. P. le Roux.

I HAVE much pleasure in directing a message to the many thousands of readers of *Farming in South Africa,* the monthly journal as well as the mouthpiece of my Department. I am well aware of the extremely useful service rendered to the farming community by this publication, and as a practising farmer, I can commend it in the strongest terms to all who are interested in the agricultural industry. This journal is, of course, in the first instance, the farmer's guide, but since agriculture is not an isolated industry, it should enjoy the attention of all who accept the irrefutable fact that Mother Earth is the fount of all life.



Agriculture is indeed the core of our national economy, particularly inasmuch as we are still a young, developing country and the farming industry affords a livelihood to so large a percentage of the Union's population. On you as farmers devolves the momentous task of utilizing our natural resources in the most effective manner. Coupled with this are the ever-increasing and higher demands of a growing population for better and increased food supplies. It is these two important goals which should ever be the aim and which should be promoted, in harmony with each other, in practice: increased food supplies on the one hand, and on the other, a wide, co-ordinated plan steering the entire process of utilization of our natural resources to a more secure, a sounder and a more productive level.

Actually these two goals are complementary—the firmer the foundations of our agricultural industry, the more easily can increased productivity be effected in the Industry. This task cannot, however, be brought to fruition by farmers alone. Our farmers are, and will remain, the pivot around which our aspirations for improved and sound farming revolves. For is it not their heritage which is directly at stake? And I know our farmers well enough to feel confident that they will not be found wanting. But the matter is one of national dimensions and importance, touching

the very roots of our entire national existence. To me as Minister of Agriculture, it is therefore most heartening to see how eager all sections of the population are to co-operate in this weighty matter. I can find no better grounds for confidence in the future of South Africa's agriculture than the appreciation by the non-farming sections of our people of the necessity for collective action in respect of this immense agricultural problem.

The State, too, has an obligation to fulfil. I can give you the assurance that it will contribute its full share. The research and enlightenment services of my Department will concentrate their efforts on this matter. Of my personal interest and goodwill you may be assured. I am at your disposal at all times for consultation and the promotion of mutual co-operation.

S. P. le Roux

Minister of Agriculture and Forestry.

New Bulletins.

Bulletin No. 284.—*The Feeding of Farm Animals (Dairy Cattle)*, by J. C. Bonsma, Division of Agricultural Education and Research, is obtainable from the Editor of Publications, Department of Agriculture, Pretoria. Price 3d., prepaid.

Bulletin No. 229.—*Soft-Cheese and Cottage Cheese* (Second and Revised Edition), by G. D. le Roux, Division of Dairying, is obtainable from the Editor of Publications, Department of Agriculture, Pretoria. Price 3d., prepaid.

Bulletin No. 286.—*The Litchi in South Africa* by Dr. R. H. Marloth, Division of Horticulture, is obtainable from the Editor of Publications, Department of Agriculture, Pretoria. Price 6d., prepaid.

Nursery Quarantines.

The following nurseries were in quarantine as at 1 July, 1948 :—

(1) Montana Nurseries, Farm Alkmaar, P.O. Nelspruit, on citrus (all), for red scale.

(2) Mooiuitsig-Kwekery, Boschrand, Private Bag Nelspruit, on citrus (part) or red scale.

(3) Dunrobin Nurseries, Bothas Hill, on poplars (all), for red scale.

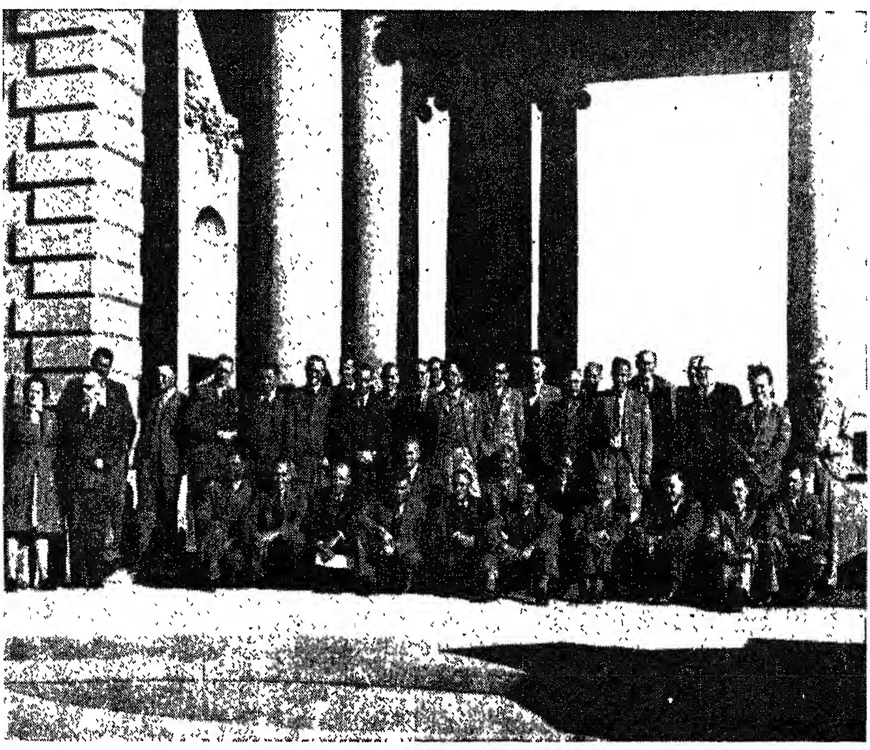
FARMING IN SOUTH ... AFRICA

VOL. 23 JULY 1948 No. 268

Editorial:

Agricultural Research.

A YEAR AGO the Division of Agricultural Education and Research convened a conference at the Union Buildings of officers of the Department of Agriculture. The purpose of the gathering was the presentation of papers by research men in the Division of Agricultural Education and Research, and the discussion of these by those present with a view to enlightening officers of the Division regarding work done by the different sections. It was considered of even more importance to receive the



Conference of Research Officers—The following are the names of some of the Officers who attended the Conference of Research Officers of the Division of Agricultural Education and Research, held at the Union Buildings, July 1947.

Standing, left to right: Miss J. S. Whitmore, Mr. P. Koch, Mr. C.R. Liebenberg, Prof. A. M. Gericke, Mr. P. J. Naude, Mr. P. J. Serfontein, Mr. E. K. Hall, Mr. W. A. Verbeek. Prof. Potgieter, Mr. M. C. Heslinga, Mr. P. L. Kotze, Mr. I. J. Smuts, Mr. J. P. Botha, Mr. J. H. Preller, Mr. E. J. Penzhorn, Mr. L. J. Henning, Dr. P. J. Schreuder, Mr. J. J. J. Kotze, Mr. J. A. van Rensburg, Mr. H. P. D. van Wyk, Mr. P. J. S. Coetzee, Mr. O. W. Schultz, Mr. C. D. B. Liebenberg.

Sitting, left to right: Mr. J. D. le Roux, Mr. D. F. Retief, Dr. J. Fisher, Mr. I. J. Nothling, Mr. J. D. Scott Dr. J. W. Rowland, Mr. J. S. Starke, Dr. H. W. Turpin (Director), Mr. R. Hirzel, Mr. G. J. Schuurman, Mr. G. S. Maré (Assistant Director), Dr. C. Tidmarsh, and Mr. J. C. Bonsma.

In order to determine what anatomical-physiological characteristics are coupled with adaptability, it is necessary to study the effect of specific environmental factors on special organs or parts of the body.

The animal breeder in the sub-tropical regions must, in the first place, determine what effect radiation, temperature and humidity have on cattle. Further, it is necessary to find out whether differences exist between breeds and types of cattle in their ability to find feed in a certain environment and in their ability to utilize such feed.

Likewise animals must possess qualities which will increase their powers of resistance against prevailing diseases. To mention only a few: they must be resistant to parasites, especially the tick, and must be immune to maladies caused by photosensitivity, such as eye cancers and keratosis of the skin. A quality far more strongly developed in some breeds than in others is the ability to avoid noxious plants.

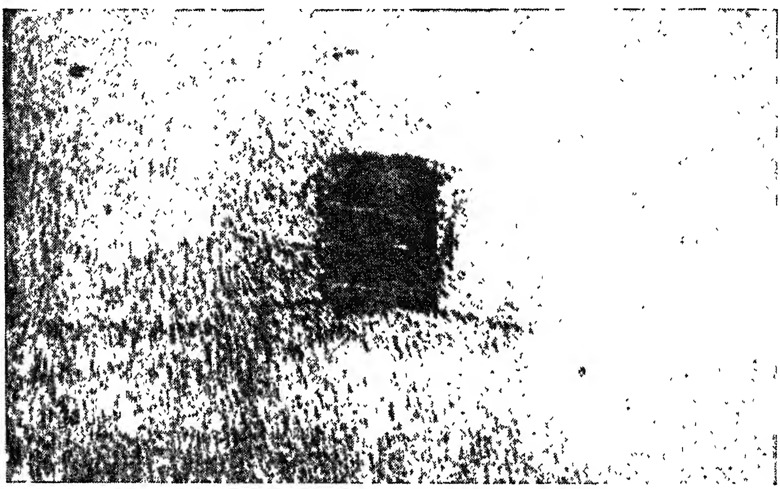


FIG 1.—Colour of hair and hide of light-cream coloured Afrikaner animal.

There is every indication that, by the careful selection of certain qualities, it is possible to develop cattle breeds, and types within breeds, which possess hereditary characteristics that will ensure their adaptability to sub-tropical climatic conditions. Such animals are endowed with resistance against intense radiation, high temperatures, and parasites furthermore, they can make the most effective use of the variable feed conditions which are typical of the semi-arid sub-tropics, and can be economically productive under these conditions.

In order to breed successfully, it is desirable to trace the reactions of the different cattle breeds, and types within breeds, and on the basis of the interpretation of such reactions it is possible to sub-divide the country into regions. In each climatic zone a breed or type can be found—or developed—which is in harmony with its environment. *The environment, the animal and its production potential will determine the breeding policy.*

An attempt will be made describe briefly the connection between certain qualities in animals and their power of resistance to climatic and a few other environmental conditions.

(1) Resistance Against Direct Solar Radiation.

Solar radiation consist of ravs of three different wave lengths, namely—

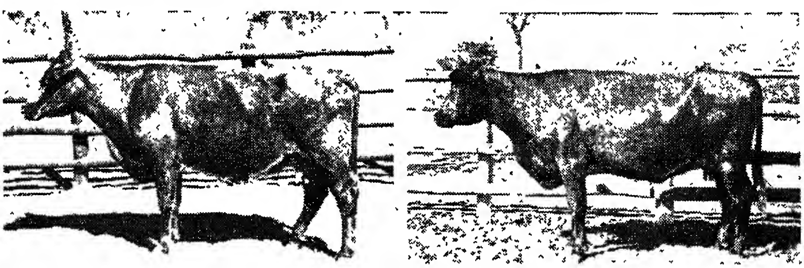
1. long-wave rays, i.e. the infra-red rays, commonly known as the heat rays;

2. rays of medium wave-length, i.e. the rays to which the eye is sensitive—the light rays or white rays, and
3. short-wave rays, which are invisible to the naked eye and which are known as the ultra-violet rays.

The effect of radiation on animals, whether good or bad, depends upon the nature and the quantity of rays falling on the animal.

All the energy supplied to man and beast is indirectly derived from radiation which sets up certain chemical reactions in the plant cell making possible the absortion of the sun's energy; radiation increases the metabolic processes, it stimulates certain animal tissues and it has a sterilising influence.

FIG. 2.—Types within a Breed. Two pure-bred Shorthorns which are half-sisters.



1. Smooth-hair type. Cow No. 078.

Cow No. 078 before the complete coat was cut with a clipper.

Cow No. 078 immediately after coat had been cut with a clipper.

The average weight of hair of four smooth-hair type shorthorn cows was 14 ozs.

2. Woolly-hair type. Cow No. 084.

Cow No. 084 before coat was clipped.

Cow No. 084 immediately after coat was clipped.

The average weight of the coats of four woolly-hair type Shorthorn cows was 52 ozs.
All the animals were clipped on 7th July, 1947.

If the intensity and nature of the radiation exceed certain limits some animals which are not resitant to intense radiation are adversely affected with resultant skin irritations or injury to the mucous membranes, for example of the eyelids and eyes.

The nature of the radiation is determined by the atmospheric strata through which the rays must penetrate—strata that act as filters, admitting or eliminating long or short-wave rays in particular.

Radiation is therefore modified by longitude and latitude, altitude, seasonal humidity and the time of day.

It is well-known that in hot regions there is a higher degree of radiation, both of heat rays and short-wave rays, than in temperate regions.

In parts of the world near the Equator radiation is more intense and may have a most injurious effect on animals.

Cattle often have hair and hide colour and other attributes designed to give the animal protection against the injurious effect of excessive radiation.

Animals differing in hair and hide colour (apart from the characteristics of the hairs as regards their powers of retaining or reflecting heat) differ also in their ability to reflect or keep out rays of different wave-length.

As already indicated, the long wave-length rays are heat rays and are red. They are effectively reflected by white, yellow or reddish-brown hair.

Light rays are also well reflected by white, yellow or reddish-brown hair. Black hair cannot reflect or filter heat or light rays to any extent.

The short-wave or ultra-violet rays are effectively reflected by yellow, reddish-brown and black hide colours.

A white, yellow or red coat with a dark hide is the ideal combination to render an animal resistant to the temperature and intense radiation of heat and short-wave rays. (See illustration 1. Section of the hide of a light cream-coloured Afrikaner ox, with a portion from which the hair has been removed).

It is, moreover, this hair and hide colour which is found among cattle and horse breeds of the tropics. One thinks, for example of the Indian cattle breeds, the Afrikaner cattle and the Arabian horses.

White hair colour and hide without pigmentation often result in injuries to the skin due to irritation caused by the short-wave rays.

Black hair and black hide is a good combination for eliminating short-wave rays.

Black cattle breeds are therefore the best adapted in those regions where the short-wave radiation is intense, for example at high altitude and where mist frequently occurs.

Parker has indicated that black animals thrive particularly well in the sub-tropical regions, provided they are not exposed for long periods to the direct rays of the sun.

Breeders must give attention to hair and hide colour with a view to breeding animals which are better adapted, rather than to breed indiscriminately animals of certain colours because of prejudice or taste.

(2) Resistance Against High Atmospheric Temperature.

In climatic regions where cattle breeds have to contend with high atmospheric temperatures, various reactions occur which maintain the animal in a condition of thermo-stability.

Apart from the alteration in the metabolism of the animal in the effort to maintain a normal body temperature, the following physical phenomena play an important part in the dispersion of superfluous heat.

The latent heat of vaporisation of water from the lungs of the animal is important in cooling the animal's body.

The evaporation of moisture from the hide's surface is most effective in animals which have well-developed sweat glands.

Those types of animal that have mainly primary hair follicles in the hide have better developed sweat and fat glands, and it can be accepted that they lose more moisture from the hide as a result of evaporation.

Cattle with a furry coat—that is, with two kinds of hair, namely a heat-retaining layer and an external protective cover cannot dispose of heat affectively.

These are animals which in hot weather readily become hyperthermic. Animals with such hairy covering have hides with two kinds of hair follicles, namely, primary and secondary.

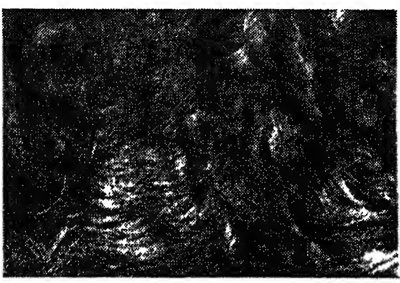
Straight hair emerges from the primary hair follicles and from the secondary, curly or semi-curled hair.

The thin curly hair forms a mat on the animal's body, and little evaporation of moisture from the skin takes place.

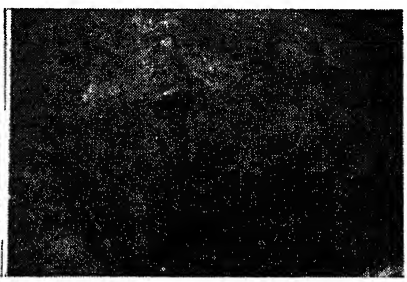
Radiation is another physical process whereby animals are able to dispose of superfluous heat. The Indian cattle breeds and the Afrikaner cattle have large well-developed dewlap and umbilical fold, which act as radiators of heat.

Tropical breeds of cattle are relatively deep, although slightly flat; they are respiratory types. The body conformation of British beef breeds not adadpted to tropical conditions, frequently changes so that they develop into respiratory types. They become deep across the chest, the belly is contracted, and the animal becomes flatribbed.

FIG. 3.—Coat of Hereford calves, three days old.

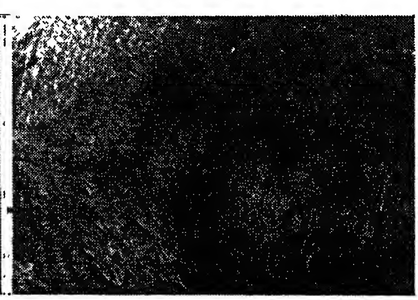


Coat of calf No. 103. The calf's hair though long, does not felt but shifts when rubbed and pressed.



Coat of calf No. 107. Calf's hair comparitively short, but felts easily when rubbed and pressed.

Coat of No. 103 when a full-grown animal.



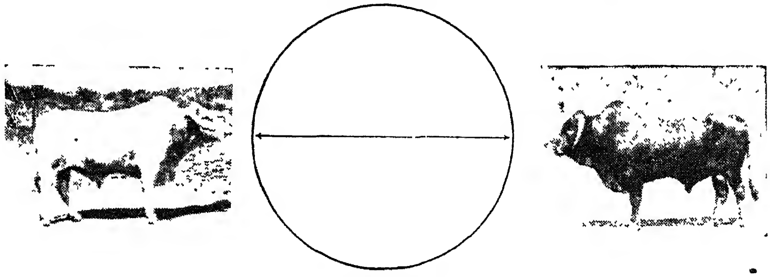
Coat of No. 107 when a full-grown animal.

In subtropical regions the the hides of smooth-coated animals, that is, animals which have mainly primary hair follicles in the hide, are usually thicker than those of the woolly types; they have a better flow of blood to the hair follicles, consequently radiation of heat in these types will be more effective.

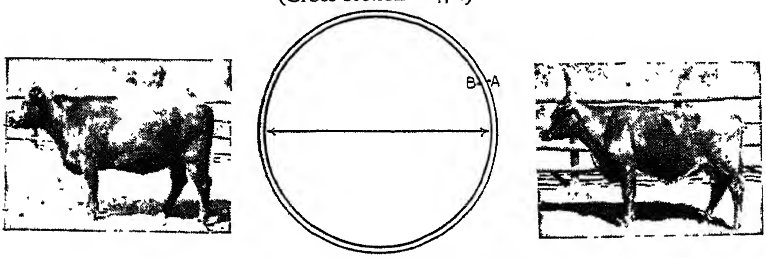
In order to develop types which will radiate heat effectively in the subtropics, smooth-coated animals should be used for breeding purposes.

If samples of hair are taken from young calves, dampened with water and then rubbed well between the hands, the hair of the smooth-coated type will rub away. The hair of the woolly-hair type will cake or flet and form a firm mass. A calf with hair revealing this characteristic does not shed its hair normally in the sub-tropics, and reacts drastically in hot weather.

FIG. 4.—Average hair thicknesses in different breeds and types of cattle.

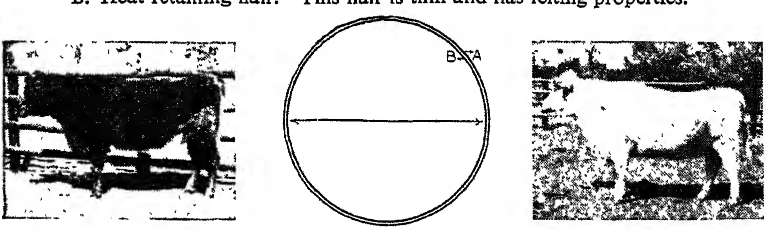


1. Afrikaner hair.
(Cross-section $52/\mu$.)

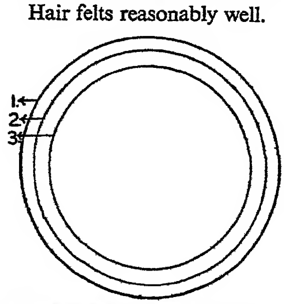


2. Hair of 2 smooth-type Shorthorn.
(Cross-section 46 and $48\cdot6\mu$.)

Two kinds of hair : A. External protective hair. This is thick hair that does not felt.
B. Heat-retaining hair. This hair is thin and has felting properties.



3. Woolly-type Shorthorn hair.
(Cross-section 40 and $42/\mu$.)
Hair felts reasonably well.



4. Diagram illustrating the average relative thickness of hair from (1) Afrikaner cattle (2) Smooth coated shorthorn cattle and (3) Woolly coated shorthorn cattle.

The entire coats of eight adult British beef-breed cattle belonging to both types, namely the smooth and dull-coated, were clipped with hair clippers as close to the skin as possible. From the four smooth-coated cattle an average of 14 ounces of hair was hemoved, and an average of 52 ounces from the four woolly-coated types (Fig. 2).

The hair coverings of the animals were subjected to a felting process in a wool factory. The hair of the smooth-coated type does not possess good felting properties and most of the hair shifts out from under the press during the felting process. The hair of the woolly-coated type of cattle felts fairly satisfactorily; it forms firmly matted pieces (Fig. 3).

The pieces of felted hair from the smooth-coated animal can be drawn apart with a pull of less than 4 lb. while those from the dull-coated type are stronger, a pull of about 25 lb. being necessary to tear the strips.

Measurements of hair thickness made on samples of hair taken from the different types of cattle within a breed also indicate clearly that the hair of the types possessing felting qualities is considerably thinner (Fig. 4).

Cattle with a coat possessing felting qualities always experience difficulty in maintaining thermal equilibrium in a hot environment, and consequently become hyperthermic. Rhoad evolved a method whereby the ability of an animal to maintain a normal temperature is expressed by a Heat Tolerance Coefficient (H.T.C.). The H.T.C. according to Rhoad is as follows:

H.T.C. = 100—10 (B.T.—101), where H.T.C. is the heat tolerance coefficient and B.T. the body temperature on a hot day. In his work Rhoad does not distinguish between age groups.

Work done by this Division indicates beyond all doubt that an animal's H.T.C. increases considerably, espesially after the second year. If a calf has a high degree of resistance and can tolerate during its first year atmospheric temperatures above 85° F., then its powers of resistance to tropical and sub-tropical conditions will undoubtedly be high.

The higher the heat tolerance coefficient of an animal in its first year, the more effective is the use such an animal makes of the feed conditions of the environment, and the better it grows.

The best method of selection for breeding animals able to maintain thermal normality under environmental conditions of high atmospheric temperature, is to test the animals before they are a year old at temperatures above 85° F., and then to breed only from those with a high H.T.C.

The table below indicates clearly how the H.T.C. of a group of four Aberdeen Angus heifers changes with age. In the case of Afrikaner cattle the differences are not so great.

Age.	0–1 year.	1–2 years.	2–3 years.	3–4 years.
Average body temperature at atmospheric temperature above 85° F.	103·3° F.	102·5° F.	101·6° F.	101·6° F.
Four Animals in each group	(142)	(127)	(121)	(94)
H.T.C.	77	85	94	94

(The figures in brackets indicate the number of observations taken on each animal.)

The young animal is a sensitive organism, and selection for resistance to tropical conditions can be made with greater accuracy on such a young animal.

In order therefore to breed animals able to maintain thermal equilibrium at high atmospheric temperatures, animals with the correct type of hair and a high H.T.C. should be selected (Fig. 5).

Resistance to Humidity.

Seath and Miller have indicated that the part played by humidity in the reactions of the animal is of little importance.

A rise of one degree in air temperature was responsible for 13-15 times as great a rise in body temperature as was a rise of one per cent. in the relative humidity.

Adaptation and feeding.—In consequence of the irregular rainfall and the high temperature of the semi-arid sub-tropics, natural grazing is deficient in protein and moisture and high in crude fibre for the greater part of the year (See Fig. 6).

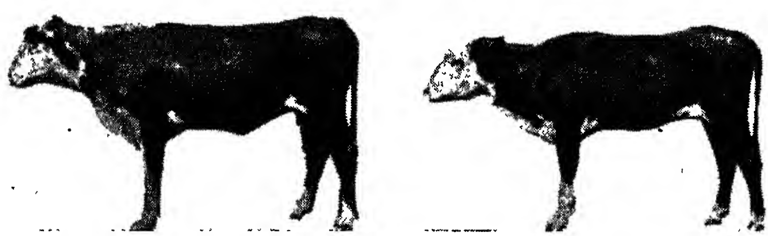
Owing to the periodic droughts, the animal must also have the ability to search for food.

The higher the animal has developed from the animal husbandry point of view, the more difficult will it be for such an animal to utilize the grazing with its high crude fibre and low protein and moisture content. If, in addition, much walking is required to reach the feed, the animal, which does not move with ease, will have difficulty in obtaining its maintenance needs. Such animals succumb in years of drought.

Appropriate, effective and adequate nutrition afford a partial but by no means complete solution to the problem of adaptation to the tropics and sub-tropics.

FIG 5.—Heat tolerance and growth in cattle.

Heat tolerance coefficient (H.T.C.) = 100 — 10 (body-temperature — 101.).



Animal No. 103. Born 17/12/40.
Age 4 years.
H.T.C. during the first year = 79 per cent.
Weight at 4 years = 1,030 lb.
Shoulder height = 124 c.m.
Length of Body = 154 c.m.
Heart girth = 175 c.m.

Animal No. 107. Born 26/12/40.
Age 4 years.
H.T.C. during first year = 60 per cent.
Weight at 4 years = 715 lb.
Shoulder height = 122 c.m.
Length of Body = 142 c.m.
Heart girth = 151 c.m.

Both photos were taken on 18/1/45 and originally reduced to a scale of 1 : 25 shoulder height.

Further, in the economic breeding of stock, it is essential that the most effective use be made of the vegetation available in the region. Consequently, a system of supplementary feeding where the necessary fodder is supplied to the animals in sufficient quantities is not a practical proposition in these regions.

In the tropics and sub-tropics, unadapted animals cannot fully utilize the feed supplied to them. In cool temperate regions the problem of adaption and environment is easily solved by feeding and shelter, but this is not the case in the sub-tropics. In other words, it is possible for a breed adapted to a warm region to grow normally in a temperate climate,

provided it receives adequate feed. The converse is, however, not true. A cattle breed developed in a cool temperature region will not thrive in the sub-tropics, notwithstanding good feeding.

If an animal becomes hyperthermic as a result of high environmental temperatures and lack of adaptability, it will automatically eat less and the whole process of normal metabolism will be disturbed.

The table below indicates clearly in this respect the differences in breed types.

Breed Type.—Differences in Characteristics of Animals.

*Breed.	Type.	Age. (years)	Maximum average weight, summer season.	Minimum average weight, summer season.	Loss in weight. (lb.)	Percentage loss of weight.	Date on which feeding became necessary.	Remarks and date when calves were weaned.
(3) Shorthorn..	Woolly.	7	872	673	199	23	1/4/1947	1/3/1947
(3) Shorthorn..	Smooth	7	953	845	109	12	18/6/1947	1/3/1947
(4) A. Angus...	Smooth	7	750	709	41	5·5	15/5/1947	1/3/1947
(3) Hereford...	Smooth	7	1,010	982	28	2·6	Not yet fed	1/3/1947
(4) Crossbred..	Smooth	7	930	860	70	7·5	21/5/1947	Fed only 1
(6) Afrikaner...	Smooth	7	1,130	970	160	13	Not yet fed	4 calves still suckling
(3) Afrikaner...	Smooth	4	928	862	66	7·1	Not yet fed	1/3/1947

* At least five animals were used in each group.

In cool temperate regions an animal adapted to sub-tropical and tropical climatic regions can maintain a normal body temperature provided it is well fed. The maintainance requirements of such an animal will, as a result of a greater power of radiating heat, be greater than those of an animal possessing a coat with heat-retaining properties.

Thus, to breed animals which, in the sub-tropical semi-arid regions, will effectively utilize the available feed resources, it is necessary to select animals which are in thermal equilibrium with the environment, which can move with ease, and which can make good use of coarse fodder.

As a result of drought conditions at the Messina Experimental Farm, the nutritional quality of the grazing deteriorated to such a degree that the cattle began to lose weight considerably. As soon as cattle showed a loss in weight of 10-15 per cent. and/or exhibited signs of weakness, supplementary feed was given. From the table it is clear that the Afrikaner breed and the truly smooth-type Hereford can overcome these conditions reasonably well.

If an endeavour is made to locate each breed in those regions which most closely resemble their original habitat, then for the hot dry climatic zones those breeds should be selected and bred which can advantageously utilize bulky feed and which are able to do without concentrates. The basis of the selection is thus ability to thrive off the veld.

An effective utilisation of roughage, that is, leaves and shrubs as well as grass, is fundamental to an economic cattle breeding industry in the sub-tropics.

Adaptation and Reproduction.—The function of growth is to a large extent determined by the animal's efficiency of feed utilization, which is again closely correlated to that of adaptation as far as the animal's thermal equilibrium is concerned. There is every indication that if the animal is not in thermal equilibrium with its environment, its metabolism is not normal either, and apparently no feeding in the world will make the animal grow properly.

All animals so constituted as to be unable to adapt themselves, suffer from chronic under-nourishment, owing to the fact that they cannot utilize the available fodder.

Chronic under-nourishment in the unadapted types can even be detected in newly born calves. The calves born after a summer gestation are puny in the case of unadapted breeds. The miniature calves of cows of the British beef breeds born in May, June and July are 20 per cent. lighter than calves of the same animals born in December-January. The small calves grow slowly and cannot make effective use of the mother's milk as their absorptive capacity is too small. The differences in weaning weights are even greater, namely 27 per cent. Such small calves were observed not only on the Messina Experimental Farm but also in Swaziland, Portuguese East-Africa and Bechuanaland.

There is no difference in the weight of calves of well-adapted animals born in summer and winter.

Underfeeding results in retardation of growth. The function of reproduction, which at the same time is a function of growth, is intimately associated with the growth of the animal. All the animals whose growth had been considerably retarded, revealed repressed sexual activity, and clinical examination as well as slaughter tests proved the sexual organs of the animals, particularly the ovaries and wombs, to be infantile.

The productive ability of a poorly adapted animal is low, and selection on a fecundity basis is an effective method of breeding for adaptability.

Adaptation and Production.—Production of meat, fat, milk, etc. are nothing more than functions of growth and if the animal does not grow normally, its productive capacity will be considerably reduced.

If an animal in the sub-tropics is adequately fed but is not in thermal equilbrium with its environment, efforts are made to evaporate as much moisture as possible from the lungs by accelerated respiration and by panting or slavering. Apart from the increased metabolism and the hyperthermal condition, which make it difficult for the animal to put on weight, the development of protein tissue, which is the most important tissue associated with the weight increases in the early stages of growth, is still more difficult, since the evolution of one molecule of protein tissue involves the addition of eight molecules of water.

Influence of the Season of Serving upon Weight at Birth.
(Messina Experimental Farm).

Breed.	Winter gestation and summer calves: Served March-April; born Dec.-Jan.	Summer gestation and winter calves: Served Aug.-Sept; born June-July.	Percentage differences in weights. Summer and winter calves.
	Weight at birth. (lb.)	Weight at birth. (lb.)	
British beef breeds......	65	52	20
Afrikaner..............	67	67	0
	Weight at weaning.	Weight at weaning.	
British beef breeds......	395	289	27
Afrikaner..............	400	400	0

Fat, a tissue almost free from moisture, is developed during the later stages of growth of the animal. The growth of unadapted cattle is such that muscle tissue, but not fatty tissue, show signs of suppressed growth. There is, however, another cause for this phenomenon, namely that the adaptation of the unsuitable animal is much lower in the first two years of its life, when protein tissue should be developed, than in the succeeding years.

The function of milk production is also a function of growth. If an animal is well adapted to its environment, it can utilize effectively the available forage and grow normally. It enables the animal to reproduce at an early age, which in turn stimulates the growth of udder tissue and milk production. The cow which potentially has a high milk production will, however, not produce efficiently if inadequately fed to supply her needs for maintenance and milk production.

An animal may, however, receive enough feed and yet be undernourished if the climatic conditions do not permit of the effective conversion of the feed. This, then, is one of the reasons why the European dairy breeds do not succeed in giving good milk yields in the tropics.

Where climatic conditions have a restrictive effect upon milk production, there the Afrikaner breed produces more milk than the British beef breeds.

In India, Sahiwal and Tharparker Zebus are being successfully bred for milk production.

Adaptability and Mortality.—In a treatise on the hereditary differences in resistance to heartwater in cattle, published a few years ago, it was pointed out that there are differences between breeds and types within a breed, which make some animals more tick-resistant than others of the same breed. It was further indicated that fewer tick-resistant animals succumb to tick-borne diseases than animals that are non-resistant to ticks. The differences in mortality between breeds are shown in the following table: —

Mortaliy among Cattle brought to Mara from Areas not Infected with Heartwater.

Date of Arival.	Afrikaners.		Exotic		Date.
	Received.	Died.	Received.	Died.	
6/9/43	118	20	24	6	23/2/45
6/9/43	20	5	30	9	1/3/46
12/6/46	6	0	30	19	1/9/46
26/6/46	25	3	—	—	.
16/9/46	63	5	—	—	—
	232	33	84	34	—

The total annual mortality of cattle at Mara, calculated on a percentage basis, over a period of ten years, is three times as great in the case of the British beef breeds as among the Afrikaner cattle, that is, if both breeds receive the same treatment and are derived from the same environment. The mortality in the crossbred herds likewise calculated on a percentage basis, is 30 per cent. higher than among the pure Afrikaner herds.

The following table indicates the differences in mortality between calves of different breeds born at Mara up to the age of one year and up to the age of five years.

Age.	Number born.			Number died.		
	Afrikaners.	Exotic Breeds.	Cross-breeds.	Afrikaners. kaners.	Exotic Breeds.	Cross-breeds.
0–1 year	308	69	1,101	24	24	149
	Number of survivors after 1 year.					
1–5 years	284	45	952	10	0	8
Age group.	Percentage died.					
0–1 year	7·79	34·78	13·53			
1–5 years	3·5	0·0	·83			
0–5 years	11·03	34·78	14·26			

From these figures it likewise appears that the mortality among Afrikaner calves is lower than among calves of the British beef breeds and crossbreds. It is also clear that not all Afrikaner calves become infected with the diseases to which the susceptible types either succumb or become immune during the first year. During the period of 1-5 years an additional 3·5 per cent. of the cattle die which have survived the first year. Among the exotic breeds there were no further deaths between the ages of 1-5 years.

Mortality among cattle is intimately associated with their adaptability. The animal adapted to a region has not only a greater resistance to infection, but it is also better able to survive disease.

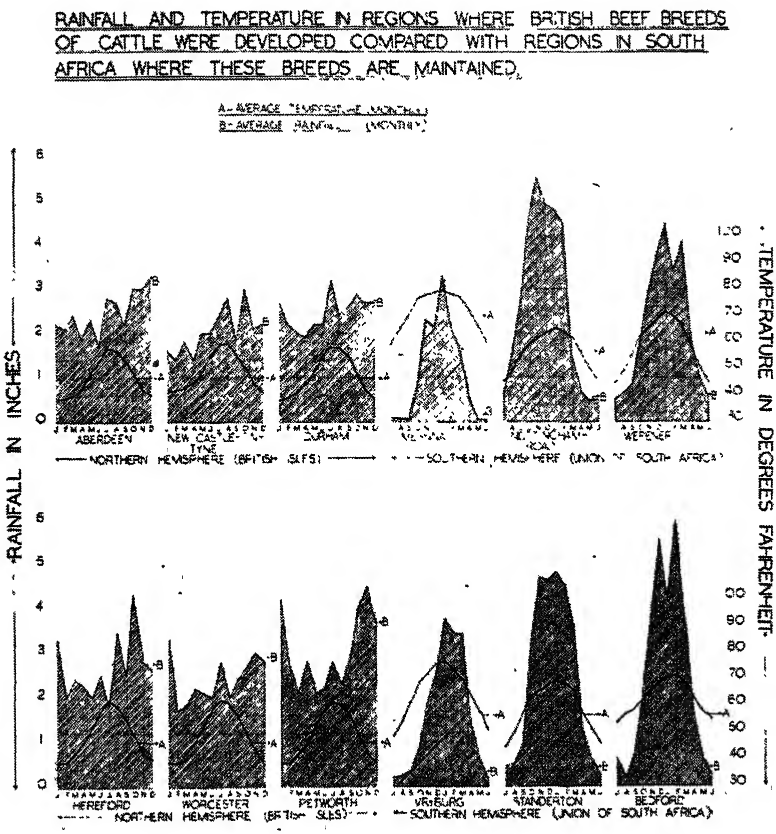


FIG. 6.

It is in this connection that attention must be drawn to the dangers of therapeutic treatment, for example, the injection of animals against heartwater. A policy which recommends the injection against heartwater of all animals in a heartwater area runs counter to a sound animal breeding policy, particularly to one formulated on a regional basis. The injection of animals against heartwater will induce farmers who, as a result of the high mortality among their cattle in the past, decided to farm with adapted types, to make another attempt to farm with breeds which—while now immune from a disease—are still not wholly adapted. Immunity from a disease such as heartwater in no way increases the animal's adaptability.

The converse is, however, true; if animals are adapted to their environment, the mortality, as a result of diseases such as heartwater, is so low that injection of the animals against the disease is not justified. The total annual mortality among the Afrikaner herd at Mara over a period of ten years was only 2·36 per cent., a percentage considerably lower than the number which die under the immunizing process of injection against heartwater. I should therefore like to emphasise that where farming is properly conducted, namely, according to a suitable breeding policy for the development of a type adapted to a certain locality and by proper feeding and treatment, then the therapeutic aspect of the treatment can be relegated to the background.

Adaptability, Photosensitivity and Epithelioma.—Skin cancers and dermatitis are usually found in cattle with white hair and a white skin. In Australia, Drabble reported that he had come across no fewer than 193 cases of skin cancer among cattle, mostly white coloured.

If cattle with white coat and skin eat certain plants, the skin becomes hypersensitive to radiation.

Hereford cattle, with their white faces and unpigmented eyelids, are susceptible to eye cancers and epithelioma.

The cancers develop exclusively on the conjunctiva in breeds where the conjunctiva is deficient in pigment.

Cancers also develop on those parts of the eyelids which are not covered with hair and which are unpigmented. Epithelioma is probably due to the effect of solar radiation and occurs on the conjunctiva and the hairless, umpigmented rim of the eyelids.

Epithelioma of the eyelids may be almost entirely prevented by breeding only from those Hereford cattle which have a ring of brown hair round the eyes, and pigmented eyelids. Epithelioma of the conjunctiva may still occur in individuals with a ring of brown hair round the eye, but only at a much later stage. Eye cancers seldom occur if the brown ring round the eye is fairly wide. Apparently there is a close connection between the colour of the hair about the eye, and the amount of pigment present in the conjunctiva.

In the breeding work with Herefords carried out by this Division, it is endeavoured, wherever possible, to use only bulls with a brown ring of hair round the eyes and pigmented eyelids.

There are a few more diseases which appear to be more prevalent among certain breeds and types within a breed, than among others. A few instances where such indications are clear, are plant poisoning and Actinomycosis. British beef breeds are more susceptible to plant poisoning than are the Afrikaner cattle.

It may also be differently stated, namely, that there is a difference in the ability of animals to distinguish between poisonous and non-poisonous plants.

There are likewise indications that Aberdeen-Angus are probably more susceptible to Actinomycosis than the other British beef breeds. The data in respect of these two diseases is insufficient for drawing decisive conclusions.

Finally, I should like to stress that it would appear that it is possible, by purposeful selection, to breed cattle types well-adapted to certain regions. Adaptability raises the economic potential of production and lowers the normal mortatity.

Methods of Fertilizer Application for Tobacco.

D. F. Retief, Officer-in-Charge, Rustenburg Agricultural Research Station.

Introduction:

THE tobacco plant requires a relatively high quantity of plant foods which, if not present naturally in the soil, must be applied in a readily assimilable and balanced form, in order that development may proceed uninterruptedly through all the stages of growth. An excess or deficiency in certain elements is liable to have an exceedingly adverse effect on the health and quality of the crop and may, to some extent, also affect the type.

To derive the maximum benefit from the various plant foods, it is necessary, therefore, not only to apply the correct quantities at the correct times, but also to place the fertilizers judiciously; in this way changes to an insoluble form or losses as a result of leaching will be minimized.

In times of fertilizer shortages it is particularly important to follow a method of application calculated to ensure the most economic utilization of the available plant foods.

Movement of Applied Plant Foods in the Soil.

To determine the most advantageous method of application, it is necessary to study what happens to the most important plant foods, viz., phoshpate, nitrogen and potash, after application.

Phosphate.—With phosphate hardly any movement takes place in any direction, even after heavy rains or irrigation, and losses as a result of leaching are neglible. In sandy soils with a high degree of acidity and a considerable iron and aluminium content, phosphates are readily changed into insoluble forms. These changes appear to take place more rapidly when the phosphate-bearing fertilizer particles are distributed in the soil and so come into contact with more soil particles. In alkaline soils, phosphates may combine with calcium to form insoluble tricalcium phosphate.

Potash moves slightly in a vertical direction in sandy soil, but usually remains within reach of the roots. In clayey soils, or where organic material is present in a high degree, potash is also changed into an insoluble form. Later it may again become available. Potash, when injudiciously applied, is inclined to damage (burn) sensitive plants. The damage is greater in sandy soils, and in hot, arid parts.

Nitrogen moves considerably, in all directions, especially when applied in an organic form. Under certain conditions, it may therefore move out of reach of the plant roots. The nitrogen is assimilated by micro-organisms and a temporary deficiency may ensue, particularly where considerable quantities of fresh organic material is present. Nitrogen is also inclined to "burn" when applied profusely in the nitrate form.

Methods of Application.

The following are the methods of fertilizer application usually followed:—

1. *Broadcasting Method.*—Here fertilizers are broadcast and mixed with the soil by means of a plough, harrow or disc harrow.

Under certain soil conditions this method is liable to aggravate the problem of unavailability of phosphates. Moreover, other plant foods not within easy reach of the roots, may also be lost. Where limited quantities are applied in this manner, plants appear to make poorer growth, especially during the young stage of development, and the yield may be poorer. On the other hand, this method does not leave a streaky effect, and gives satisfactory results under dryland conditions, where the roots move over a large distance in search of moisture. A well-developed root system enables the plant to assimilate larger quantities of other essential plant foods. With this method, plant foods are less likely to be carried away during irrigation than when the fertilizers are placed in the irrigation furrows. This is a cheap method, especially when suitable implements are used.

2. *Row Application.*—In this case the fertilizers are strewn in the planting furrow and mixed with the soil in the furrow. Thus, the roots of the plant immediately move in a higher concentration of plant foods than would have been the case if the same quantity had been broadcast over the entire area. From the start the plant makes rapid growth—an advantage which it is likely to retain right up to the stage of maturity. In certain circumstances sensitive plants are liable to "burn" and the subsequent crop may benefit in strips from this method of application. Where irrigation is applied in the planting furrow, plant foods may be transported.

   This method is more expensive than the broadcasting method but since it is conducive to a better output, the farmer is more than compensated for the extra costs involved.

3. *Planting-hill Method.*—The planting hills are pegged off, and the fertilizers applied over a very limited area. As a rule they are mixed slightly with the soil, but the concentration remains high and the possibility of "burning" in sensitive plants persists. The advantages and disadvantages of this method are similar to those of the row method, save for the fact that the residual effect on the subsequent crop is less uniform.

4. *Split or divided Application.*—Here a portion is applied at the transplanting stage, and the balance later on, either together or at intervals. A combination of any of the previously described methods may be followed, e.g. kraal manure broadcast and fertilizer applied in the row. This method has great possibilities, since various types of fertilizer can be applied at the correct time and in the most effective manner. No fertilizer need be applied where plants failed to grow.

   As against this, several applications entail more expense, and the danger exists that a necessary application will not be made in time, or will not be made at all.

   The necessity for applying phosphatic and potash fertilizers before or during the planting process, and not much later, in the form of a top-dressing, calls for special emphasis.

5. *Band Method.*—The fertilizers are placed, by means of an implement, in two bands or strips at a given distance from the plant or seed and at a given depth in the soil. These distances and depths can be varied to suit the requirements of the soil or crop.

At first the plant roots do not come into contact with the fertilizers and the danger of "burning" is reduced. The fertilizers do not mix with the soil, and hardly any conversion of salts into the insoluble form takes place. The costs of application with an implement should not be prohibitive.

Where, as in the case of tobacco and other crops which are transplanted, fertilizers are administered ahead of time, this method will not be easy to apply inasmuch as the centre of the two bands will not be located in transplanting. The result will be a streaky residual effect on the subsequent crop.

During the past decade the band method has given exceedingly promising results in experiments with a large variety of crops, and this method therefore merits more attention.

Experiments on Tobacco.

With the object of determining the best and most economical method of applying kraal manure and artificial fertilizer for the production of snuff tobacco, an experiment was laid out during the 1938-39 season at the Sub-tropical Horticultural Research Station, Nelspruit, Fertilizer was applied as follows:

Kraal Manure		20 tons per morgen.
Fertilizer Mixture :	Superphosphate (19·1)	537 lb. per morgen.
	Potasium Sulphate	300 lb. per morgen.
Blood Meal		330 lb. per morgen.
Sodium Nitrate		258 lb. per morgen.

The quantities represent an average application.

Treatments :—

1. Kraal manure broadcast, artificial fertilizer broadcast	M (B)	F (B)
2. Kraal manure broadcast, artificial fertilizer ½ broadcast, broadcast, ½ in rows	M (B)	F (BR)
3. Kraal manure broadcast, artificial fertilizer, in rows	M (B)	F (R)
4. Kraal manure broadcast, artificial fertilizer in planting hills.	M (B)	F (H)
5. Kraal manure ½ broadcast, ½ in rows, artificial fertilizer broadcast	M (BR)	F (B)
6. Kraal manure ½ broadcast, ½ in rows, artificial fertilizer, ½ broadcast, ½ in rows	M (BR)	F (BR)
7. Kraal manure, ½ broadcast, ½ in rows, artificial fertilizer in rows	M (BR)	F (R)
8. Kraal manure, ½ broadcast, ½ in rows, artificial fertilizer in planting hills	M (BR)	F (H)
9. Kraal manure in rows, artificial fertilizer broadcast	M (R)	F (B)
10. Kraal manure in rows, artificial fertilizer ½ broadcast, ½ in rows	M (R)	F (BR)
11. Kraal manure in rows, artificial fertilizer in rows	M (R)	F (R)
12. Kraal manure in rows, artificial fertilizer in planting hills	M (R)	F (H)

The soil is sandy and derived from granite. It contains a relatively high percentage of iron and aluminium, is acid (pH 5·5 – 6·0) and is situated against a slope.

The experiment was moved to a new site from year to year in order to eliminate the cumulative effects of previous treatments.

Below is a reflection of the rainfall gauged from the time of application of the fertilizers up to the harvesting of the crop:—

Season.	*Rainfall.*	
1938–39	39·0 inches	abnormally high.
1939–40	22·7 inches	high.
1940–41	16·6 inches	normal.
1941–42	15·1 inches	normal.
1942–43	17·9 inches	normal.

The following are the costs of application for the quantity of fertilizers:—

Fertilizer.	*Cost of Application per morgen.* £ s. d.
Kraal Manure—20 tons per morgen—	
(*a*) Broadcast	1 15 0
(*b*) In the rows	3 15 0
(*c*) Half broadcast, half in the rows	4 0 0
Artificial Fertilizer—1,425 lb. per morgen.	
(*a*) Broadcast	0 12 6
(*b*) In the rows	1 5 0
(*c*) Half in the rows, half broadcast	1 8 6
(*d*) In the planting hill	2 0 0

The costs of any combination of treatments can therefore be calculated.

The calculation of the results was based on the 5 per cent. level.

The results are given in the tables below:—

Table I.—*Yield of Tobacco in Weight and Value (per Morgen).*

	Average Yield During.										Average for 5 Years.	
	1938–39		1939–40		1940–41		1941–42		1942–43			
	lb.	£	lb.	£	lb.	£	lb.	£	lb.	£	lb.	£
M (B) F (R)	1,843	51	2,238	97	2,550	102	2,795	128	2,283	91	2,342	94
M (B) F (H)	1,728	42	1,868	73	2,660	116	2,792	128	2,295	86	2,268	89
M (B) F (BR)	1,670	41	1,938	81	2,505	106	2,845	131	2,007	75	2,282	87
M (B) F (B)	1,658	42	1,900	81	2,390	102	2,512	115	2,002	75	2,092	83
M (BR) F (R)	1,770	50	2,113	90	2,545	118	2,855	134	2,423	100	2,341	98
M (BR) F (H)	1,735	42	1,738	66	2,593	112	2,790	132	2,347	90	2,241	88
M(BR)F(BR)	1,720	43	1,920	81	2,510	106	2,658	123	2,140	83	2,189	87
M (BR) F (B)	1,690	42	1,873	76	2,303	92	2,272	102	2,085	77	2,045	78
M (R) F (R)	1,575	39	1,985	81	2,988	136	3,100	145	2,622	101	2,454	100
M (R) F (H)	1,835	47	1,983	78	3,058	139	3,035	140	2,460	101	2,474	101
M(R)F(BR)	1,690	44	1,803	67	2,708	120	2,750	123	2,430	106	2,276	92
M (R) F (B)	1,440	32	1,628	58	2,468	105	2,390	108	2,297	93	2,045	79
Average....	1,696	43	1,916	77	2,607	114	2,732	126	2,283	90	2,247	90
Significant difference	—	—	—	—	375	24	203	13	268	15	143	8

Table II.—*Comparison of Kraal-Manure Distribution Methods (for all distributions of Artificial Fertilizers).*

	Average Yield During.										Average for 5 Years.	
	1938–39		1939–40		1940–41		1941–42		1942–43			
	lb.	£	lb.	£	lb.	£	lb.	£	lb.	£	lb.	£
M(B)......	1,725	44	1,986	83	2,528	110	2,735	126	2,148	81	2,224	89
M(BR).....	1,729	44	1,911	78	2,488	107	2,642	123	2,248	87	2,204	88
M(R)......	1,635	41	1,849	71	2,805	125	2,820	129	2,452	101	2,312	93
Average....	1,696	43	1,916	77	2,607	114	2,732	126	2,283	90	2,247	90
Significant	—	—	—	—	185	12	100	—	133	8	80	4

TABLE III.—*Comparison of Artificial Fertilizer Distribution Methods. (For all Distributions of Kraal Manure).*

	AVERAGE YIELD DURING.										AVERAGE OR 5 YEARS.	
	1938–39		1939–40		1940–41		1941–42		1942–43			
	lb.	£	lb.	£	lb.	£	lb.	£	lb.	£	lb.	£
F(B).......	1,596	39	1,800	72	2,388	100	2,392	109	2,128	82	2,061	80
F(BR).....	1,693	43	1,887	76	2,573	111	2,753	126	2,193	87	2,220	89
F(R).......	1,729	47	2,112	89	2,695	123	2,917	136	2,438	97	2,378	98
F(H).......	1,766	43	1,863	72	2,770	122	2,873	134	2,368	92	2,328	93
Average....	1,696	43	1,916	77	2,607	114	2,732	126	2,283	90	2,247	90
Significant difference	—	—	—	—	88	6	48	3	63	4	36	3

Discussion of Results.

The differences between treatments during the first two seasons were not significant, probably due to the exceptionally high rainfall. Moreover the yields were also reduced by partial drowning of the crop.

During the last three seasons the rainfall was normal and during these seasons the differences were significant.

In so far as the 1940/41 season is concerned, the M(R) F (H) and M(R), F (R) treatments appeared to yield the largest quantity of tobacco. From table II it is clear that kraal manure is more effective when applied in the rows than when broadcast, or when the two methods are combined. As regards fertilizer, the row and planting-hill methods of application are superior to the other in all respects (table III). Where the fertilizer is broadcast, the yields are lower by 382 lb. in weight and £22 in value. than when placed in the planting hill.

The results of the following years were in most respects the same as for the 1940/41 season.

A summary of the experimental data for the entire period leads to the following conclusions:—

1. For the quantities of kraal manure and artificial fertilizer used, it is clear that the kraal manure may be broadcast or applied in the rows, but that artificial fertilizer should definitely not be broadcast. Broadcasting artificial fertilizer detracts from the value of even a good accompanying method of kraal-manure application.
2. Similar conclusions may be drawn in regard to the value of the yield. Fertilizer applications in the rows give a total monetary yield of £18 per morgen in excess of that from broadcasting, which more than offsets the slightly higher application costs attendant on the row application method.
3. The split method, of applying both manure and artificial fertilizer cannot be recommended, in view of the lower vields and higher application costs. Since the planting-hill method does not give a bigger yield than the row method and is, moreover, more expensive, it is not recommended.

4. "Burning" was more common in tobacco plants coming into direct contact with fertilizers, as e.g. in the planting-hill method. Once commenced, growth was, however, considerably more rapid, than with the other treatments, this advantage having lasted for longer in dry than in wet years. Plants enjoying such an advantage are able to reach maturity sooner.
5. In no season did the tobacco experience a real drought, and accurate indications as to the plants' drought-resisting capacity as affected by methods of application, could not be obtained. Root development was more or less the same for all treatments.
6. That application methods are subject to a strong seasonal influence is patent. Thus, the excessive rains of the first two seasons eliminated the favourable effects of desirable methods of application.

Modified Experiment on Tobacco.

Upon completion of the first portion of the experiment described above, the treatments were modified somewhat, with the object of comparing two quantities of kraal manure with two methods of application of manure and artificial fertilizer. The "half broadcasting, half in the rows" treatments were omitted, but in all other respects the experiment remained the same. The rainfall was normal for both years of the experiment.

The results for the two seasons are given in the following table.

TABLE IV.—*Tobacco yield per morgen.*

	AVERAGE YIELD FOR				AVERAGE FOR TWO YEARS.	
	1943–44		1944–45			
	lb.	£	lb.	£	lb.	£
M(B) F(B)....	2,102	90·4	1,940	60·6	2,024	75·5
M(B) F(R)....	2,420	106·9	2,473	90·4	2,446	98·6
M(R) F(B)....	1,998	78·9	1,958	54·0	1,978	66·4
M(R) F(R)....	2,523	112·0	2,583	95·1	2,553	103·5
2M(B) F(B)....	2,503	112·9	2,243	80·5	2,373	96·7
2M(B) F(R)....	2,855	134·1	3,005	125·9	2,930	130·0
2M(R) F(B)....	2,493	112·7	2,688	108·3	2,590	110·5
2M(R) F(R)....	2,573	114·8	2,945	125·1	2,759	119·9
Average........	2,433	107·8	2,480	92·5	2,456	100·1
Significant difference.....	183	13·3	120	15·4	—	—

Once again the effect of application methods is, indeed, striking. The row method of fertilizer application gave an increase in the yield of £26 per morgen as against the broadcasting method.

Again the differences between the broadcasting and row methods in so far as the application of manure is concerned, were negligible. Compared with the application of 20 tons per morgen, the application of 40 tons of kraal manure per morgen gave an increase of approximately £28 per morgen, which amply offsets the costs of the additional quantity of kraal manure.

TABLE V.—*Comparison of Kraal Manure Distribution Methods. (For all Distributions of Artificial Fertilizer.)*

	AVERAGE YIELD FOR				AVERAGE FOR TWO YEARS.	
	1943–44		1944–45			
	lb.	£	lb.	£	lb.	£
M(B)..........	2,265	98·6	2,208	75·5	2,236	87·0
M(R)..........	2,260	95·9	2,270	74·5	2,265	85·2
2M(B).........	2,678	123·5	2,623	103·1	2,650	113·3
2M(R).........	2,533	113·7	2,810	116·6	2,456	115·1
Average........	2,433	107·8	2,480	92·5	2,456	100·1
Significant difference.....	128	6·6	57·5	10·9	—	—

TABLE VI.—*Comparison of Artificial-Fertilizer Distribution Methods. (For all Distributions of Kraal Manure.)*

	AVERAGE YIELD FOR				AVERAGE FOR TWO YEARS.	
	1943–44		1944–45			
	lb.	£	lb.	£	lb.	£
F(B)...........	2,275	98·6	2,208	75·9	2,241	87·2
F(R)...........	2,593	116·9	2,753	109·1	2,673	113·0
Average........	2,433	107·8	2,480	92·5	2,456	100·1
Significant difference	90	6·6	82·5	7·5	—	—

Striking in this experiment is the fact that 40 tons of kraal manure in an unfavourable combination of application methods, yield less than 20 tons applied in the correct manner. [Compare treatment 2 M(B), F(B) with M(R), F(R)].

Not only is there a difference of £6. 8s. in favour of the M(R) F(R) treatment, but the cost price and application costs of 20 tons of kraal manure must be added—a total amount of approximately £23. 10s.

These figures indicate very clearly the necessity for the most economical and efficacious application of fertilizers.

Experiment on Maize.

In view of the fact that the two experiments on tobacco do not include the band method of application and in view of the urgent necessity for information in this connection, a maize experiment was commenced at Nelspruit during the 1945/46 season.

The following treatments were applied:—

A. Artificial fertilizer broadcast and harrowed in.
B. Artificial fertilizer placed in the row.
C. Artificial fertilizer applied by means of a maize planter.
D. Artificial fertilizer in 2 bands, 3 inches on either side of the seed.

The fertilizer was applied in three quantities:—

(1) 300 lb. mixture C per morgen.
(2) 600 lb. mixture C per morgen.
(3) 900 lb. mixture C per morgen.

The effect of treatments on the germination of the seed was carefully observed and the percentage germination as well as the yields of the various treatments are given in the following table.

TABLE VII.—*Percentage Germination and Yields of Maize per Morgen.*

	Percentage Germination	Yield per morgen.
	%	(in bags).
A1	80·7	9·38
A2	74·5	9·46
A3	75·6	13·50
B1	75·4	11·52
B2	76·2	13·12
B3	76·2	15·00
C1	60·8	9·46
C2	62·9	11·78
C3	55·4	13·58
D1	80·8	17·12
D2	87·5	17·88
D3	83·3	19·12
Average	74·1	13·40
Significant difference	0·58	1·14

TABLE VIII.—*Results of Application Methods (for all Quantities of Artificial Fertilizers).*

	Percentage Germination	Yield per morgen.
	%	(in bags).
A	76·9	10·78
B	75·9	13·22
C	59·7	11·62
D	83·8	18·04
Average	74·1	13·40
Significant difference	0·3	0·61

TABLE IX.—*Results of Quantities of Artificial Fertilizer (for all Methods of Application.)*

	Percentage Germination	Yield per morgen.
	%	(in bags).
300 lb.	74·4	11·85
600 lb.	75·3	13·06
900 lb.	72·6	15·30
Average	74·1	13·40
Significant difference	2·9	0·33

[*Continued on page* 494.

The Bag Problem.

A Summary of the Possibilities of Fibre Production in the Union.

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THE bag problem still remains critical and is even becoming worse. The possibility that the Union will ever again be able to obtain sufficient bags and hessian from India, even though the Indian sanctions may be lifted, is so slight and uncertain that in due course the Union will be compelled to solve the problem by itself. Any relief which may later be obtained from India can at best be of a temporary nature only. The population in that country is increasing at such a rate, namely over five millions per annum, that the question of feeding her increasing teeming millions is paramount, and the area under jute production has accordingly been contracted considerably, and the extra area thus freed devoted to food production. During the past few years the jute producing areas have been reduced by about 22 per cent.

Phormium tenax (*New Zealand hemp*).—Zululand.

There appears little hope of supplementing the Union's requirements from elsewhere, as there is a great world shortage of bags, and such fibres which could be substituted for jute. The Union is therefore compelled to do everything in its power to produce its own fibre requirements for bagmaking. The State fully realises the serious position, and everything is being done to investigate the possibilities of promising fibre plants with a view to growing the country's requirements, and establishing factories which would supply the shortage in bags and hessian.

Fibre Production for Bagmaking.

The question of producing in the Union a fibre suitable for manufacturing grain bags has been given serious attention since the early days of the war. From 1940 onwards the Department of Agriculture has been making attempts to test out certain fibre plants, particularly Sunnhemp and New Zealand hemp, (and lately "wilde stokroos"). Many samples of these fibres have been tested locally and overseas, with varying results. Large samples of Sunnhemp fibre have again recently been sent to spinning and weaving firms in the United Kingdom for bagmaking tests. The preliminary reports are encouraging.

Southern Rhodesia has been successful in designing a machine for separating Sunnhemp fibre from the stalk, thus making it possible to produce this fibre economically in South Africa, by eliminating the very expensive hand separation of fibre. This machine, The Gundry decorticator, has also been used for "wilde stokroos" with fairly good results. Although by no means perfect, the defects could easily be remedied, and engineers are giving this matter the necessary attention. In the meantime a private firm in the Union has at last succeeded in solving the vexed question of economical decortication (extracting the fibre).

A bag factory has been erected at Benoni by a private concern which will turn out an appreciable number of bags in the near future. Woolpacks are already being turned out at the factory at a rate of several hundred thousand per annum. This is not sufficient, the factory must be able to procure the necessary suitable fibre from which the bags could be manufactured. A certain quantity of fibre, namely 8 thousand tons has been imported from the Belgian Congo and South America, but the Union will have to produce its own fibre to be independent of the vagaries of foreign supplies.

During October and November 1946, a comprehensive report was written by the Department of Commerce and Industries in co-operation with the Department of Agriculture and submitted to the Government. This report deals with the possibilities of certain promising fibre plants, both indigenous and exotic, and the payability of growing such crops, together with costs of manufacturing bags, etc. The result is that a private firm undertook to erect a coarse fibre spinning and weaving plant for turning out hessian for bag manufacture under certain guarantees from the Government. The factory costs over £500,000 and is now practically completed, as mentioned earlier. During the coming year about 8,000,000 grain bags will be manufactured. The factory is capable of turning out over 15,000,000 bags per annum.

The question of the necessary local jute substitutes to supply the factory, is being tackled seriously. The fibre plants which could be grown on a large scale within a few years are fortunately to be found in the Union, some indigenous and others imported.

Fibre Plants.

A large percentage of the fibre plants of the world are native to the tropics and are cultivated to the greatest extent within the boundaries of the tropics, although some of them, for instance the conspicuous example of cotton, are grown far outside of the limits of the tropics. The fibre plants which are grown on a commercial scale in temperate climates are not very numerous, flax and true hemp being the chief ones apart from cotton, and to a smaller extent Deccan hemp (*Hebiscus cannabinus* and *H. diversifolius*) and New Zealand hemp (*Phormium tenax*). Both flax and true hemp (*Cannabis sativa*, or *dagga*) are also grown in the

tropics, but flax has never assumed commercial importance as a tropical crop although it has been grown on a fairly large scale on the highlands of Kenya, while hemp is grown in tropical countries chiefly as a drug plant and not for its fibre.

The commercial vegetable fibres of the world are derived from various botanical structures of fibre plants. The fibres are in general more or less filamentous or thread-like products, consisting of the tougher and more resistant parts of the plants and possessing considerable strength and flexibility. In virtue of these characteristics, they are of great economic importance for the manufacture of durable materials, such as are required for clothing, sacking, cordage and many other purposes. The number of plants from which valuable fibres could be obtained is very large. For example, an account of fibre plants of the Philippines mentions over 750 such plants in the Philippines alone. Africa probably has an even larger number. An attempt therefore, to discuss most of the plants from which fibres could be obtained would be impossible in a brief review. Only the main ones will be discussed.

Classification of Fibres.

For our purpose fibres may be classified (*a*) in accordance with the part of the plant from which they are derived and (*b*) according to the economic uses to which they are applied. The two schemes may be referred to as morphological and economic respectively.

(*a*) *Morphological Plants.*

(1) The fibres of a miscellaneous series of products, such as coir, the fibres of which the husk of the coconut is composed; piassava, which consists of the ribs of the sheathing leaf-stalks of various palms; bass or raffia, composed of epidermal strips peeled from the leaves of certain palms; broom corn; and Mexican whisk, the roots of a species of grass.

(2) The woody fibre of trees which is used for paper-making and which consists of the various elements of which the fibre-vascular tissue of wood is composed.

(3) The hairs borne on the seeds or on the inner walls of the fruit. Cotton is the principal member of this class, which also includes kapok and other flosses. Each hair consists of a single long, narrow cell, free from transverse partitions.

(4) Fibres which are obtained from leaves and constitute the fibro-vascular system of these organs, also called "*structural-fibres*". This class includes the commercial fibres known as Manila hemp, Sisal, Mauritius hemp, bowstring hemp, and New Zealand hemp. These fibres consist of long strands composed of a large number of small, elongated cells, the so-called ultimate fibres, varying in length from 0·05 to 0·25 inch. Fibres in this class are commonly known as *hard* fibres.

(5) The fibres of which the inner bark or bast tissue of stems is composed, also known as "*bast fibres*". The class is represented by flax, true hemp, jute ramie, asclepia (milkweed), "wilde stokroos", Urena lobata and related products. The long strands in which these fibres appear in commerce are not individual cells, but like those under (4) are aggregations of numerous small elongated cells or ultimate fibres. In the case of jute and its allies they are only about 0·1 to 0·2 inch in length, those of flax and true hemp are about one inch long, whilst those of ramie are much longer, and vary from 3 to 12 inches or more. The bast fibres are *soft* fibres.

For the purpose of bag manufacture only coir under group (1), cotton under group (3), and groups (4) and (5) are of importance.

(*b*) *Economic Classification.*

The classification of fibres in accordance with their industrial uses must necessarily be somewhat arbitrary, as some of the products are employed for several purposes and therefore appear in more than one class. Cotton, for example, is not only used for textiles, but is also employed for the making of cordage, paper, gun-cotton and many other purposes.

(1) *Fibres used for the manufacture of textiles.*—The principal members belonging to this group are cotton, flax, true hemp, jute, Deccan hemp (wilde stokroos) and ramie.

(2) *Cordage fibres.*—This group includes manila, sisal, Mauritius and New Zealand hemps. (The fibres of group (1) are also more or less largely used for the making of twines and ropes).

(3) *Brush and mat fibres.*—In this group are included piassava, coir, palmyra, palmetto, certain agaves, and broom corn.

(4) *Fibres used for stuffing materials in upholstery.*—Kapok and other flosses are used for this purpose.

(5) *Paper-making fibres.*—The fibrous material of various trees and grasses are extensively used for the purpose.

(6) *Miscellaneous.*—Any fibrous materials not included in the foregoing groups, such as raffia, wicker, rattan, etc., fall under this group.

Investigation of Fibres.

There are several methods of investigating fibres, namely: (1) observation of the general characters of the product, including colour, length, softness, lustre and fineness, (2) microscopical examination, (3) chemical examination, and (4) measurement of tensile and torsile strength which may be determined roughly by hand and more accurately by machine.

These methods need not be described here. Suffice it to say that only by experience and careful observation can the general characters, sufficient for all practical purposes, be fairly satisfactorily determined, while microscopical examination is necessary for determining the character of the cellulose and the proportion of true cellulose present. The cellulose of fibres may be divided into two classes, (1) the pecto-celluloses and (2) ligno-celluloses. The former are represented by the fibre substance of cotton, true hemp and flax, and consist of the true or typical cellulose associated with so-called pectic bodies, which can be removed by treatment with alkali. The ligno-celluloses form the fibre substance of such products as jute, Manila, and sisal. The properties of fibres of different plants can thus be determined.

Cotton (*Gossypium spp.*)

Cotton is, beyond question, the most important of all known fibres. All wild species of cotton are tropical and perennial, but it is grown commercially almost universally as an annual crop and largely in the temperate zones. The Southern States of the U.S.A. produce by far the greatest amount of cotton and have supplied as much as two-thirds of the world's demand. India, Egypt, Uganda and South America, produce appreciable quantities, but other countries supply only a mere fraction. The Union of South Africa produced over 16,000 bales of lint of 500 lb. each in 1926, but, during the past few years the production had dropped to less than 3,000 bales. This was due largely to low prices and the

great demand and high prices paid for food crops. Now, however, the price of cotton in the Union has gone up from 4½d. per lb. immediately before World War II to 16d. per lb. As a result the area under this crop is again rapidly being extended and the prospects are better than for years. Apart from the usage of fine textiles, cotton wool, motor tyre casings and the warp of the large number of woolpacks now being manufactured in the Union, cotton is not used for bagmaking other than for small pockets for flour, tobacco, etc. The price is too high for grain-bag manufacture. The country can therefore not look to increased cotton production as a solution of the bag problem. Union cotton is of a very high quality and its production for fine spinning and weaving could be encouraged in suitable areas of South Africa.

Sisal *(Agave sisalana rigida).*

Sisal is an " agave " and native to Central America. It is propagated either by suckers or bulbils. Suckers are young plants which develop at the base of the mother plant, and the bulbils are peculiarly modified structures which develop from the flowers on the branched inflorescence of the flowering pole. About 3,000 bulbils develop on each pole. Sisal is ordinarily planted about 8 feet by 8 feet. The first crop of leaves matures at the age of 3 to 4 years, and the plant sends up a tall, flowering shoot at the age of 8 to 9 years. When the plant " poles " it dies. During the whole life of the plant about 180 leaves are developed and these yield on an average 8 to 10 pounds of fibre. The bearing period of sisal is about 5 years and the annual production is approximately one ton per morgen.

Although sisal is extremely drought resistant and will grow where most other crops would utterly fail, an annual rainfall of 20 inches or more is desirable. The plant thrives in a great variety of soils, even very shallow soil. Although it can withstand a fair amount of frost the best sisal is grown in frost-free areas. In the Union the areas round Louis Trichardt, Tzaneen, eastern lowveld of the Transvaal, Zululand and coastal Natal are very suitable.

A large quantity of water is required for washing the fibre after decortication, i.e. after removal of the fibre from the leaves. Sisal has the great advantage that its fibre can be extracted by machines called decorticators and raspadors, the former being very expensive and the latter comparatively cheap. As the fibre is hard it is not so suitable for bagmaking, but is used principally for cordage, i.e. ropes, binder twine, cables and suchlike.

There are a few small plantations in the Union, one at Barberton and the other at Hibberdene, Natal, which are being worked profitably.

Mauritius hemp *(Furcraea gigantea).*

This plant is a near relative of sisal, and what has been said about sisal can be applied to Mauritius hemp also. There is only one small plantation of this crop in the Union, namely at Hibberdene.

Bowstring hemp *(Sansevieria spp.).*

Bowstring hemp, also known in the Union as " Bushman sisal ", " Kaffirwortel " and " Sjambokbos ", is found wild all over the bushveld. There are many different varieties varying in length from 2 feet to 7 feet long or more. They are herbaceous, stemless plants with swordlike root-leaves. The leaves yield a fine, white, strong fibre which can be used

for the same purposes as sisal and Mauritius hemp. The fibre content is the same as for sisal, namely about 3 to 4 per cent. of the green leaf. The leaves are decorticated with the raspadors or decorticators used for sisal. In Kenya and Tanganyika where the giant Sansevieria grows wild in abundance it was at one time exploited for fibre, but as the areas near the railway line became depleted and as it grows very slowly, in spite of its many advantages, its commercial exploitation was replaced entirely by sisal in those countries. Nowhere has it been grown extensively on a commercial scale and although it grows in great abundance in the Union bushveld, the species are short, mostly 12 inches to 18 inches long, and the costs of transportation and decortication are high. The fibre is softer than sisal fibre and very strong. A few acres of the gaint Sansevieria were planted at Hibberdene in 1941, but it has not made much growth in 7 years.

The wild plant in parts of Northern Rhodesia and elsewhere may be exploited by natives as a small family affair, but it is doubtful whether it would ever be able to displace sisal on an economic basis.

New Zealand hemp *(Phormium tenax)*.

Phormium is a liliaceous plant, similar to gladioli, with leaves upwards of 8 feet long and 3 to 4 inches wide, arising from the base of the plant near the ground. It is indigenous in New Zealand where many varieties grow wild in great profusion. The most profitable strains contain about 15 per cent. of fibre, but it is claimed that some have been found which yield as much as 20 per cent.

This plant has for many centuries been used by the Maoris for fibre production. Since 1870 appreciable quantities have been exported from there to other countries, principally to the United Kingdom. At present New Zealand is manufacturing woolpacks from this fibre, and as many as 800,000 woolpacks have been made per annum. Grainbags can also be made from this fibre, which even though not so soft a fibre as jute, it is not as hard as sisal. Ideal conditions for its growth are found in the heavy rainfall areas of the Zoutpansberg, Tzaneen, the foothills and valleys of the Drakensberg of the eastern Transvaal and Swaziland and in the coastal and mist-belt areas from Zululand right down to Knysna and George. Although it can withstand drought fairly successfully, a rainfall of 30 to 50 inches per annum evenly distributed over the greater portion of the year, is best. The plant produces the best quality fibre at altitudes of less than 3,000 feet. It grows in many types of soil and is not exhaustive.

The few commercial plantations in the Union have their origin from St. Helena plantations which were established from introductions from New Zealand.

At Melmoth, Zululand, a plantation of 800 acres has been established with the available rootstocks or "fans". A "fan" when planted increases from 4 to 10 in three or four years time. Since the New Zealand authorities have prohibited the export of Phormium plants, the Union has to rely mainly on the multiplication of the limited number of rootstocks in the country. It will therefore take several years before, say, eight or ten thousand acres can be planted. Phormium "fans" are planted six feet apart in rows of 8 feet wide. Once established it lasts for 20 years and longer, and needs replanting only when the plants become too dense for economical harvesting and when they begin to crowd each other out. The yields of fully established plantations are two tons of fibre per acre.

Like sisal this crop has the great advantage that the extraction of the fibre is done by machine. A stripper or decorticator with the necessary buildings and other facilities would cost in the neighbourhood of £3,000. Such a unit could handle about 150 acres of full-grown Phormium. The leaves have to be decorticated within two days of harvesting. A plentiful supply of water is necessary for washing the freshly decorticated fibre.

Phormium fibre is lustrous, medium soft and varies in colour from nearly white to pale reddish brown. It is used chiefly for the manufacture of ropes, twines, cable cores, mattings and woolpacks. Of all fibre plants which are now being investigated as to their suitability under Union conditions, Phormium, with the exception of the Hibiscus species (wilde stokroos), is one of the most promising.

Sisal—30 months old.

Jute *(Corchorus capsularis and C. olitorius).*

Jute is perhaps the fibre of second commercial importance. Jute fibre is used for a great variety of purposes, but chiefly for gunny bags, cordage, cheap carpets, cloth, curtains, etc. There are many fibres better than jute, but the great prominence of this fibre in manufacturing industries is due to the ease of cultivation in India and the lack of mechanical or technical difficulties in manipulating and spinning of the fibre. India enjoys a virtual monopoly of jute production, and apart from Brazil, jute cultivation in all other countries has not been a commercial success. Even in Java it did not prove a success, *Hibiscus cannabinus* and *Hibiscus sabdariffa* (Indian sorrel or roselle) having displaced jute almost entirely in that country.

There is no possibility of growing jute successfully and economically in the Union, with perhaps the possible exception of a small swampy area between St. Lucia Lake and west and south of the lower Umkuzi river which might be suitable. *Corchorus olitorius,* however grows wild in several areas of the lowveld.

Hemp *(Cannabis sativa or dagga).*

This fibre plant known as Italian hemp and Russian hemp is the true hemp and yields an excellent fibre. It is grown on a large scale in Italy, Russia and to a smaller extent in the Balkans and the U.S.A.

(Kentucky, Minnesota and Wisconsin). As the plant contains a potent stupefying narcotic substance, its cultivation in the Union is strictly prohibited by statute. Natives are very fond of this so-called South African opium, and as it has a very deleterious effect on the smoker's health and self-control, it is a serious offence to be in possession of any part of the plant except the imported fibre which does not contain any harmful substances.

Flax *(Linum usitatissium).*

Flax for fibre is suited to the winter-rainfall areas of the Cape Province, and flax for seed for oil extraction and cattle cake (linseed) can be grown in the highveld of the Transvaal and eastern Orange Free State. As the fibre is very expensive, its extensive use for bagmaking must be ruled out. It could be used to better purposes for high-grade expensive products.

Milkweed *(Asclepia).*

The plant grows wild in many areas of the Union and it yields a valuable fibre, apart from the floss. The yield of fibre is small, and it has not been grown on an extensive commercial scale anywhere in the world. The plant, however, has the advantage that no retting is needed for extraction of the fibre.

Ramie *(Boehemeria nivea).*

Ramie or China grass is the fibre obtained from a plant of the natural order Urticaceae, or nettle family, which grows to a height of eight feet. Unlike the common nettle it is devoid of stinging hairs. The fibre is derived from the inner bark or bast tissues of the stems. Ramie is the most durable, the strongest, and lightest vegetable material extant. It is 8½ times stronger than cotton and 4 times stronger than flax. Ropes, fish lines, nets and sail made of ramie will withstand from 75 to 100 years of the hardest wear and tear. The Egyptians used it thousands of years ago to wrap their mummies in, and today the same cloth is still strong. The fibre has very many uses and is, in fact, *the wonder fibre.* The plant is very easy to grow and thrives in almost any type of soil and climate with an annual rainfall of 25 to 30 inches. It can withstand slight frosts, but it grows better where the climate is hot, moist and equable, ensuring rapid and continuous growth.

Propagation is by means of seed and root-stocks. It grows very rapidly. The plant eclipses its fibrous competitors in still other ways. It is planted most easily from root cuttings, and within six or eight weeks under favourable conditions the stalks grow up to cutting size. Replanting is done only after five or six years, and in the meantime it produces three to four crops per annum. Insects and diseases do not appear to damage the plant. The protein content of the leaf-meal is 25½ per cent. compared to 21 per cent. of young dried lucerne. Other advantages are many, but the above will suffice. Why then has ramie-fibre production not made much headway during the past? Why has the world to depend solely on China for the small quantity produced?

The problem is separation and economical degumming of the fibre. In China one man can remove the fibre from the stalks by hand at the rate of from three to six pounds a day—it is slow and expensive work and can be performed economically only where labour is very cheap and plentiful and where time is no object. Until, therefore, a suitable decorticating machine is invented, there is little prospect of producing this fibre on a large scale.

Few fibres have racked more good brains. Hundreds of men have spent years and fortunes trying to work out a way to extract the fibre cheaply from the ramie plant and to condition it satisfactorily for use. Successful decortication and degumming on a commercial scale has stumped man after man. Over 1,000 patents have already been taken out in the U.S.A. but none has proved very successful so far.

However, there are reports that a few owners of fairly large ramie plantations in Florida, Alabama, Louisiana and Eastern Texas have at last solved or are solving the problem of decortication. Should this be true, then production of ramie on a big scale in different parts of the Union, particularly in the northern and eastern Transvaal and the coastal areas of Zululand, Natal, Eastern Province and Knysna-George, seems a probability and even a certainty.

A perfect ramie decorticator may or may not yet have been constructed. The degumming problem may or may not have been fully solved. Indications are that the approach is near. The weight of brains and capital now brought to bear on the job is sufficient to arouse definite expectations.

Urena lobata *(Ceasar weed, Pahka grass Aramina or Congo jute).*

This bast fibre plant is similar to "wilde stokroos" and is grown for its fibre in Madagascar, Brazil and the Belgian Congo. The fibre is an excellent substitute for jute, but the yield is somewhat low and it cannot be compared to that of the "wilde stokroos" which is nearly three times as great as that of Urena lobata. Seed of this fibre plant and several others have been obtained from Brazil and elsewhere and has been grown experimentally during the past season at Rustenburg, and Mt. Edgecombe, Natal with disappointing results.

Sunnhemp *(Crotalaria juncea).*

As the possibilities of Sunnhemp fibre are discussed in a separate article elsewhere in this issue, nothing will be said about it here.

"Wilde Stokroos" *(Hibiscus cannabinus and diversifolius).*

Nearly all species of Hibiscus, both ornamental and commercial, as well as most species of the whole mallow family, produce a strong and servicable fibre in the bark. Only a few species of Hibiscus, however, have been used for the commercial production of fibre. "Wilde stokroos" (*Hibiscus cannabinus* and *Hibiscus diversifolius*), the Deccan hemp of India, and known in commerce as "Bimlipatam jute" and "Java" jute, is perhaps the most valuable member of the genus as a fibre plant. It is found wild in Asia and in Africa. For quality the fibre is understood to be as good as, and possibly superior to, average jute, for which it forms an efficient substitute in the manufacture of cordage, sacking, or any of the coarse textiles. It is grown very largely in Russia, Brazil and in the Madras Presidency, though it is cultivated in other parts of India, and also in Java, and by natives in many parts of Africa.

This plant is one of the most promising fibre plants of the Union. It grows very easily and produces a heavy yield of excellent fibre, namely two tons per morgen and even more, provided soil and climatic conditions are ideal. Yields of 4 tons of fibre are not uncommon in India. The dry stalks contain about 20 per cent of fibre.

"Wilde stokroos" is an annual and grows wild all over the warmer areas of the Union, such as the Springbok Flats, the Lowveld of the Transvaal and Swaziland, Zululand and Natal. This plant must not be

confused with the so-called "wilde stokroos" of the Knysna forests and also found in parts of the eastern Cape districts, namely *Sparmannia africana* which belongs to the same family as true jute (Corchorus spp.) *Hibiscus sabdariffa,* known as Indian sorrel or roselle, may, however, for all practical purposes be classed under "wilde stokroos". It is not indigenous to the Union and is here grown for its fruit or seedpods which make a delicious jelly, not unlike cranberry jelly, but more delicate in flavour. In Java the plant is grown for its excellent fibre and is displacing "wilde stokroos" as jute substitute in that country. It requires, however, more favourable rainfall than "wilde stokroos".

Red flower (*Hibiscus cannabinus*) or Deccan hemp.

"Wilde stokroos" or Deccan hemp is a most suitable substitute for jute when grown judiciously for fibre. The seed must be sown on well prepared land at the rate of about 40 lb. per morgen. It must be sown thickly to prevent branching. Fibre from branched stalks is inferior and difficult to extract. Sandy soils are considered the best type of soil, provided they are fertile, but the crop grows readily in black turf and any soil in which kaffircorn and cotton thrive. At altitudes higher than 4,000 feet above sea level the season is usually rather short, and although the plant grows on the Highveld and produces a good fibre, the growth is slow and the plant is short, hence it produces a short fibre. In the warmer areas of the Union, and with a rainfall of not less than 18 inches during the growing period, it grows up to ten feet high. Such plants yield a long, valuable fibre. Sowing takes place in October and November after the first soaking rains.

It takes about four months after sowing, depending on the rains, before the plants are full-grown. When most of the lower flowers have opened and formed seed-pods, and before all the top flowers have opened, the plants are ready for harvesting for fibre extraction. They are then cut just above the ground with a sickle or a mower. The mower eliminates handling. In India and Brazil, however, harvesting is done by hand, and women are also employed for this work.

The harvested plants are left on the land to dry and are then tied in bundles ready for retting at any convenient time. Retting consists in steeping the stalks in water (dams, pools or retting tanks) for a week to thirty days depending on the temperature of the water. The higher the temperature the sooner retting is complete. If the plants are removed too soon, retting will not be complete, decortication will be difficult and the fibre coarse, hard and brittle; on the other hand, if they are kept too long in the water, retting proceeds too far and the fibre will be weak and poor. Retting requires experience and good judgment.

When retting is complete, the bast can easily be removed by hand from the wet stalks and cleaned by beating it repeatedly on the water. This is a slow and expensive process and cannot be done economically, except where there is a plentiful supply of very cheap labour. The more economical method is to remove the fibre by a machine called a decorticator. The stalks are first dried in the sun and then decorticated by machine at any convenient time when other farm work is slack.

Since there are at present practically no retting facilities, the owner of the £500,000 factory at Benoni has built a series of retting tanks, and erected a decorticating plant at Nelspruit costing £30,000 to give the industry a start until such time as co-operative retting tanks and decorticating facilities are built in the producing areas, or farmers have mastered the technique of doing their own retting in dams, rivers or cement retting tanks. This plant will be able to handle about four to five thousand tons of stalks or straw per annum at Nelspruit.

At present there are two main problems connected with this budding new industry, namely, lack of experience in retting and lack of decorticating machines.

The market for the fibre is practically unlimited. The Union requires for grain-bags and sugar pockets alone over 50,000 tons of fibre per annum.

Concluding Remarks.

As can be seen from the foregoing, a fibre industry to supply all the Union's needs cannot be created overnight. If everything goes according to plan, it will be three or four years before the industry can be firmly established. In the meantime bags will be manufactured largely from fibre to be imported from the Belgian Congo and elsewhere, supplemented by any suitable fibre produced in the Union.

There are still several other fibre plants, such as Sunnhemp, which might eventually be grown commercially in South Africa to supply the additional needs of the bag industry, but, while further investigations are being conducted, an early solution to the serious bag problem, which to-day, is of major national importance, seems possible for the time being by the exploitation on a large scale of Phormium tenax and the "wilde stokroos" species.

Poultry Farming.

Bulletin No. 241. *Poultry Farming in S.A.* which was out of stock, has been reprinted and is again obtainable from the Editor of Publications, Pretoria.

(Price 1s. per copy, post free.)

Experiments with Sunn Hemp Fibre.

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During 1942, when the scarcity of grain bags began to loom large, experiments in the decortication of Sunn Hemp (*Crotalaria juncea*) were carried out at the Hartebeestpoort Agricultural Research Station.

Such experiments were necessitated by the desire on the part of the Department to gain information in respect of decortication, the retting process, fibre yield per morgen, quantity of seed needed per morgen and the stage at which the plants should be reaped to assure the maximum yield of fibre. It was also necessary to submit the fibre to manufacturers' tests and to gain information in respect of the manufacturing costs.

Since the summer of 1941-42 was too far advanced for the commencement of sowing experiments, samples were taken of Sunn Hemp, grown on the different plots of the Research Station reserved for green fertilisation and seed production.

Method of Harvesting.

The plants were cut with sickles and samples taken of plants at the following stages of growth, viz., the young-pod, full-pod and ripe-pod stage. It was found that after exposure to the sun for two or three days, the leaves had dried sufficiently to be easily shaken off. The stalks could then be bound and allowed to dry in stooks. Later on the thin shoots or tops of the plants were removed, and these with the leaves were left on the land to be ploughed in.

Preliminary Experiments.

For experimental purposes some of these samples were retted in an earth dam used for conserving water for irrigation, in the autumn when the temperature had already fallen sharply.

After the retting, and while the stalks were still wet, various methods of decortication by hand were tried out, but it soon became clear that the process was too slow to be economical.

The following observations were further made at this stage:—

1. When wet fibre is dried it tends to be viscous.
2. There is little difference noticeable between the fibre of Sunn Hemp, which has already begun to form pods, and that of plants more advanced.
3. If retting is discontinued too soon the fibre tends to be hard and ribbon-like, while excessive retting results in an increase in the percentage of tow (short fibre) at the expense of the long fibre.
4. The fibre of sun-bleached stalks has an attractive light-straw colour if clean water is used for retting. Muddy water gives the fibre a dirty colour which is not easily removed.
5. Thin stalks become sodden more rapidly than thick ones, and contain more fibre.
6. Dry Sunn Hemp stalks contain about 6 per cent. uncombed fibre.

On the basis of these observations, it was decided to proceed with the experiments and during the summer of 1942-43 an experiment was initiated for the purpose of establishing the stage at which the plants should

be cut for maximum fibre yield, and the best stand in terms of the quantity of seed per morgen. Later on in the year two reinforced concrete tanks were erected for retting purposes. A machine designed for the decortication of dry Sunn Hemp after retting was then obtained from Southern Rhodesia.

Sunn Hemp Fibre Experiment. (1942-43).

Object:—To determine the quantity of Sunn Hemp seed required per morgen, and the stage of growth at which the Sunn Hemp should be cut to ensure a maximum fibre yield.

Method :— Size of plot : 0·027 morgen.
Plan : Split plot-randomized arrangement, with rates of seeding as main plots, and stages of harvesting as sub-plots.
Repetitions : Three.
Quantity of seed per morgen : 100 lb., 150 lb., 200 lb., 250 lb. per morgen.
Variety : *Crotalaria juncea.*
Date of sowing : 19/11/42.
Date of reaping : (1) Flowering stage (advanced) 20/4/43.
(2) Pod stage 17/5/43.
(3) Mature stage 3/6/43.
Method of reaping : Cut with sickles, leaves shaken off, stalks bound in bundles and dried in stooks and flower or seed-tops chopped off later.
Retting and decortication : The stalks from each sub-plot were divided into three separate lots. The three lots were retted simultaneously and decorticated separately. The final weight of fibre from each plot representst the product separate rettings and decortications.
Weights were taken of stalks before retting and of fibre after decorti cation.

Results.

Fibre Yield in lb. per Morgen.

Seed sown per morgen.	Stage at which cut.						Average yield.	
	Flowering stage.		Pod stage.		Mature stage.			
(lb.)	Fibre p/m.	As per cent.	Fibre p/m.	As per cent.	Fibre p/m.	As per cent.	Fibre p/m.	As per cent.
100.......	275·3	58·9	348·2	74·5	398·8	85·3	340·77	72·92
150.......	418·5	89·6	484·0	103·6	563·0	120·5	488·50	104·53
200.......	348·2	74·5	495·1	106·0	608·6	130·3	483·97	103·57
250.......	403·7	86·4	644·4	137·9	619·8	132·6	555·97	118·97
Average...	361·4	77·3	492·9	105·5	547·6	117·2	467·30	100·00

	Average for rate of sowing.		Average for cutting stage.		Interaction.	
	Fibre p/m.	As per cent.	Fibre p/m.	As per cent.	Fibre p/m.	As per cent.
Standard deviation..........	22·44	4·80	19·44	4·27	—	—
Significant difference........	77·77	16·64	59·63	12·76	—	—
Value of error..............	12·20		22·93		1·51	
Error must be at P·05.......	4·76 N1 = 3 & N2 = 6		3·63 N1=2 & N2=16		2·74 N1=6 & N2=16	

Conclusions.

On an average, more fibre was obtained from plots on which 250 lb. of seed per morgen were sown than from those less densely sown, and the best single yield was obtained when harvesting was done at the pod stage. This last-mentioned yield is, however, not significantly higher than those from the plots on which 250 lb., and 200 lb., per morgen were sown and when cutting was carried out at the mature stage. From the tendency indicated, more fibre can be expected from the 200 lb. seed per morgen than from the 150 lb seed per morgen plot, since the highest fibre yield was obtained from the 250 lb. seed per morgen plot.

Since Fusarium wilt disease made its appearance, the experiment could not be proceeded with on the same soil, and since it was evident that cutting at the flowering stage can be eliminated and that further observations were necessary to decide whether or not the rate of sowing should be increased, it was decided to plan the experiment differently and resume work elsewhere.

Sunn Hemp Fibre Experiment. (1943-44).

Object... To determine what stand of Sunn Hemp is the best for fibre yield, and whether cutting is better at the pod than at the mature stage.

Plan..... Size of plot harvested......... $^1/_{120}$ morgen.
Arrangement............... Randomized.
Rate of planting............ 100 lb., 150 lb., 200 lb., 150 lb., and 300 lb. seed per morgen.
Repetitions................. Four.
Date of sowing............. 3/12/46.
Date of harvesting.......... (1) Pod stage................. 15/4/44.
(2) Mature stage.............. 26/6/44.

Results.

Sunn Hemp Fibre Yield in lb. per Morgen (1943-44).

Rate of seeding per morgen.	Cutting stage.	Fibre per morgen.	As percentage.
1. 100 lb.....	Pod stage........................	460·8	66·93
2. 100 lb.....	Mature stage.....................	496·8	72·15
3. 150 lb......	Pod stage........................	735·6	106·84
4. 150 lb.....	Mature stage.....................	622·8	90·45
5. 200 lb.....	Pod stage........................	655·2	95·16
6. 200 lb.....	Mature stage.....................	736·8	107·01
7. 250 lb.....	Pod stage........................	905·7	131·54
8. 250 lb......	Mature stage.....................	657·9	95·55
9. 300 lb.....	Pod stage........................	824·4	119·73
10. 300 lb.....	Mature stage.....................	789·3	114·64
	Average..........................	688·53	100·00
	Standard deviation...............	36·05	5·24
	Significant difference..............	104·50	15·18
	Value of error.....................	14·99	
	Error must be at P·01.............	3·14	
		N1=9 & N2=27.	

Conclusion.

Although there is little difference in fibre yield between that from the 200 lb. and 300 lb. seed per morgen plots (both cut at the pod stage), the

yield from the stand of the first-mentioned is significantly better than that from the remaining plots cut at the pod stage.

SUMMARY: 7 = 9 But 7 > 10, 6, 3, 8, 5, 4, 2, 1.
and 9 >28, 5, 4, 2, 1.

It will be noticed that there is no significant difference between the yield from the 300 lb. seed per morgen (cut at pod stage) and that from the 300 lb. seed per morgen cut at the mature stage. Why this should not be the case in respect of the 250 lb. seed per morgen cannot be determined. (In the previous season the yield from 250 lb. seed per morgen cut at the mature stage was second best.)

For further comparison, the average yield of all the stands cut at the pod stage was established and compared with that of all those cut at the mature stage, e.g.:

Average yield of 5 stands at pod stage 716·34 lb. fibre per morgen.

Average yield of 5 stands at mature stage 660·72 lb. fibre per morgen.

General Conclusion after Experimenting for Two Years.

Although in both years the best yield under these conditions was obtained from a crop sown at the rate of 250 lb. seed per morgen, cut at the pod stage, and since a period of two years only is covered and certain deviations occurred in the experiments, it would appear that it is unnecessary to sow more densely than 250 lb. seed per morgen and that the pod stage is possibly the best stage at which harvesting should be done.

Manufacturers' Observations.

In November, 1943, 900 lb. of short fibre (tow) was sent to a Durban firm for testing. The report indicated that the weight lost in processing is very considerable and that there should be more long fibre with the short to facilitate the passing through the machine.

At the same time 590 lb. of long fibre and 270 lb. of short fibre were sent to a Johannesburg firm which specialises in the manufacture of twine. The short fibre was useless, and the long fibre presented difficutlty in its tendency to cake. The best means of utilization was to mix it with sisal in equal proportions.

A quantity of 370 lb. of long fibre together with 270 lb. (long fibre) from the Subtropical Horticultural Research Station, Nelspruit, were also sent to a Durban firm for shipment to a firm in Dundee, Scotland.

The finding was that the fibre was unsuitable for processing with flax machinery.

Efforts were made to put it through jute machinery and although, to a certain extent, it is possible to process with this type of machine, it was found, after various tests, that it takes about three times as long to weave the same quantity from it as from jute.

Observations about the fibre, indicated, *inter alia*, that there was still far too much ribbon-like fibre and that it should have been retted longer; also that the stubble ends should be retted longer to ensure greater uniformity. Colour resulting from water is no drawback in the processing of fibre.

It was further indicated that the stalks should be cut shortly after the flowering stage has been reached.

In 1946, after the bag position had begun to deteriorate, another consignment of 1,455 lb. of long fibre and 2,141 lb. of short fibre was sent overseas with a view to establishing how it might be utilized after certain changes in the machinery had been made. The result is being awaited.

Costs.

The experiments indicate that 500 to 600 lb. of long fibre per morgen may be expected.

The following is a general statement of estimated costs per morgen by approximation:—

	£	s.	d.
Ploughing and sowing, 1 morgen	0	10	0
Seed (old prices)	2	0	0
Manual cutting, 15 labourers @ 2/- per day, 1 day	1	10	0
Shaking off leaves, binding and packing in stooks, 15 labouers, 1½ days @ 2/- per day	2	5	0
Chopping off of tops, 15 labourers for 1 day	1	10	0
Filling of tubs, washing, removal and drying, 6 labourers for 3½ days @ 2/- p.d.	2	2	0
Decortication, 6 labourers, 100 lb. per day @ 2/- per day	3	0	0
	£12	17	0

(No provision was made for watering and baling.)

From the above, the production costs appear to be about 6d. per lb. The costs could be reduced if a machine could be found for cutting the crop on the land with a minimum of damage to the stalks, and another for chopping or cutting off the tops more expeditiously.

This gives rise to the thought that it might be possible, in our densely populated Native reserves, where the climate is suitable and manual labour cheaper, to produce Sunn Hemp at a lower cost.

Another advantage to be considered is that the leaves and stubble remaining on the land considerably enhance its fertility. The leaves contain more fertilising properties than the stalks and should, together with the cut tops be left on the ground. It was noticed that wheat sown on the fibre plots grew too luxuriantly, especially on those plots which were the last to be cut before the sowing season.

Excellent compost was made of the masses of broken stalks after decortication. The only loss was that of the soluble constituents during retting and these may perhaps also be utilized in watering cultivated lands.

Sunn Hemp Retting Experiments.

Following upon the first observations made in 1942 for the purpose of gaining more information, it was decided to continue the experiments under circumstances which could be better controlled.

The aspects on which information was required were:—

1. The relative merits of stagnant or running water for effective retting and
2. The length of time required for effective retting.

During the winter of 1943 two reinforced concrete tanks of internal dimensions, 30 ft. by 7½ ft. by 2¾ ft. were erected for retting tests. Water was laid on with pipes and taps, from a neighbouring dam and provision was made for an outlet. The supply and discharge were so arranged that the water could flow through the entire length of the tanks and the bundles of stalks were placed transversely to the flow of the water.

The pipes and taps were adjusted at the outlet side, so that the water at ground level and at the surface could be discharged simultaneously without disturbing the constancy of the water-level. Each tank contained 3,000 gallons of water, of which 500 gallons were displaced every hour by the above-mentioned arrangement.

In order to keep the stalks immersed, small pillars were erected in and on the base of the tanks. Near the top of each pillar a hole was made through which a half-inch iron rod could be passed. The bundles of stalks were pressed down by wooden poles passed under the iron rods and over the bundles.

Each tank could hold a 1,000 lb. of stalks, but it was found that 900 lb. is a good load for ensuring that there is no compaction at the bottom, and at the same time, that a water-cover about 8 inches deep may be maintained. The volume of water displaced by the 900 lb. of stalks was not determined.

Effects of Stagnant and Slow Running Water Compared.

Under the circumstances it was not possible so to regulate the temperature of the water that it could be determined how long it would take effectively to ret a given sample of stalks at a certain temperature. Since the atmospheric temperature might affect the process considerably, at most, certain observations only could be made to serve as a guide under such conditions.

On 20th September, 1943, 900 lb. of stalks were placed in each of the tanks which were subsequently filled with water. The flow of water was then so regulated that a steady stream continued to flow through the one tank, while the supply to the other was cut off. In the case of the running water the supply and the discharge were adjusted to compensate each other. Temperature readings of the water in both tanks were taken in the morning, at midday and in the late afternoon. Retting proceeded rapidly and judging by the amount of gas given off and the froth formed, it would appear, that it was more rapid in the tank with stagnant water. From the third day the stalks were examined daily, and on the 27th it was decided to remove the bundles which had retted sufficiently. The second and third layers in the tank with stagnant water were only ready for removal on the 28th and 29th, respectively.

After decortication the following results were obtained:—

(*a*) From the tank with running water: Of 900 lb. stalks retted from 20th September, 1943 to 27th September, 1943, 73 lb. of fibre were obtained, both clean and strong with a small quantity of ribbon-like fibre.

(*b*) From the tank with stagnant water: Of 900 lb. of stalks retted from 20th September, 1943 to 27th, 28th and 29th September, 1943, 22¾ lb. of fibre were obtained, both dirty and poor, with a high percentage of ribbon-like fibre.

It is feasible to deduce from this that in the tank with stagnant water the retting process was less uniform.

The following table gives the temperature readings taken over the abovementioned period:—

Average Water Temperatures of Tanks: 20th September, 1943 to 27th September, 1943, in ° F.

	Morning.	*Afternoon.*	*Evening.*	*Average.*
Tank with running water:				
(*a*) Of water running in	64·4	79·8	71·2	71·8
(*b*) Of water running out (above)	62·6	78·3	76·0	72·3
(*c*) Of water running out (below)	62·2	66·2	68·2	65·6
Average of (*b*) and (*c*)	62·4	72·3	72·1	70·0

Tank with stagnant water:	*Morning.*	*Afternoon.*	*Evening.*	*Average.*
(*a*) Of water running in..............	—	—	—	—
(*b*) Stagnant (above)..................	60·9	82·0	77·2	73·4
(*c*) Stangnant (below).................	63·2	64·7	64·8	64·2
Average of (*b*) and (*c*)................	62·1	78·4	76·0	68·8

The same experiment was repeated on 23rd October, 1943 and the stalks removed on 26th and 27th October, 1943 in the following order:—

(*a*) Tank with running water—two top layers removed on 26th October, 1943.
Tank with running water—bottom layer removed on 27th October, 1943.

(*b*) Tank with stagnant water—surface layer removed on 26th October, 1943.
Tank with stagnant water—two bottom layers removed on 27th October, 1943.

The fibre obtained from the bottom layer in the tank with running water was fairly good, while there was still a considerable percentage of ribbon-like fibre present in the fibre of the two top layers from the same tank, which shows that the stalks should have remained in the water a day longer.

The fibre from the stalks from the tank with stagnant water was ribbon-like and hard.

Average Water Temperatures of Tanks: 23rd October, 1943 *to* 27*th October,* 1943.

Tank with running water:	*Morning.*	*Afternoon.*	*Evening.*	*Average.*
(*a*) Of water running in..............	69·8	77·8	73·8	73·8
(*b*) Of water running out (above)......	69·4	78·3	76·7	74·8
(*c*) Of water running out (below)......	69·5	72·6	76·0	72·7
Average of (*b*) and (*c*)................	69·4	75·4	76·3	73·7

Tank with stagnant water:	*Morning.*	*Afternoon.*	*Evening.*	*Average.*
(*a*) Of water running in..............	—	—	—	—
(*b*) Stagnant water (above)............	68·5	82·8	79·5	76·9
(*c*) Stagnant water (below)............	68·3	70·3	69·6	69·4
Average of (*b*) and (*c*)................	68·4	76·55	74·7	73·2

From the two series of temperature readings the following deductions were made:—

1. That in the morning the temperature of the water of the bottom and at the surface was, with one exception, almost identical in almost all cases (to a certain extent this must have been so during part of the night too). It is noteworthy that in September, when the nights were still cool, the surface water in the tank with stagnant water was cooler than the water at the bottom. The explanation may be that the night air cooled the surface water, and fermentation, taking place at the bottom, heated the water there.
2. That during the day, in the case of the tank with running water, the warm water could be carried down from above, at the same time raising the temperature of the water at the bottom from 2 to 6 degrees when compared with that of the stagnant water.
3. That in the case of the tank with stagnant water, the temperature of the water at the bottom continued to remain uniformly low.
4. That the average temperature of the water at the bottom of the tank with running water is from 1·4 to 3·3° F. higher than that in the tank with stagnant water, while in the average temperature of the surface water, the converse was the case, with a difference of from 1·1 to 2·1° F.

If the water temperature only is considered, the process can, with running water, in a measure, be so regulated as to ensure more uniform retting of the upper and lower layers.

The suspicion arose that another difference in the conditions existed. Consequently, samples of the water and gas were taken for analysis and on 8th November, 1943, the Division of Chemistry reported on it as follows:—

Sample.	*Resistance, 60°F.*	p*H.*
Fresh water	550	8·4
Discharged water (above)	580	7·3
Discharged water (below)	540	6·8
Stagnant water (above)	220	6·7
Stagnant water (below)	195	5·9

According to this report, these figures point to the fact that substances with an acid reaction are released during the process. The presumption that H_2S is present, is unfounded since no positive reaction for sulphur was found. The gas is inflammable and in all probability consists of a mixture of hydro-carbon elements. The blacking on silver coins is probably due to the splitting up of protein.

During 1942, when the first retting experiments were conducted, use was made of an earth dam, the mass of water of which exeeded by far the quantity of Sunn Hemp. The results in fibre obtained were comparatively good. During 1942, a small earth dam was used of a very much more limited water capacity in comparison with the quantity of material retted. The results in fibre obtained correspond with those from the tank with stagnant water.

It would appear, therefore, that when the quantity of stagnant water is very limited in proportion to the quantity of material to be retted, the likelihood exists of an excessive accumulation of elements with acid reaction. The greater difference in temperature during the day taken near the surface and deeper, may further contribute to lack of uniform retting.

In respect of the periods for retting for the different months of the year, it was noticed that the duration in April was from 7 to 8 days, in July from 10 to 13 days, in September from 6 to 7 days and in December-January from 3½ to 4 days. In other words, the warmer the air and water temperatures, the shorter the period required for retting.

Discussion on Ribbon-like Fibre and Retting.

According to description(1) the final Sunn Hemp fibre varies in length from 0·2 to 0·4 inches and is approximately 0·0012 inches broad. The commercial fibre is therefore a band or strip of short fibres held together by gummy resinous constituents, and with reference to the plant, it is a bast fibre. It is clear, therefore, that a middle course or method should be followed with retting, which, on the one hand, will circumvent excessive loss of cohesive matter resulting in poor "fibre", and on the other hand, will not retain too much cohesive matter which may cause the "fibre" to be hard and „ribbony".

With reference to the retting process, the description by Boyce(2), relative to the process with hemp (*Canabis sativa*) is interesting. According to him the resinous gum is not soluble in water, but soluble in the natural destruction by a decomposing fermentation resulting from immersion of the stalks in soft water from 5 to 10 days, according to the temperature. Also, alkaline and neutral soapy solutions will have the same effect in from 3 to 5 days when warm and within 24 hours when cold. Furthermore, during fermentation acids develop which adversely affects the softness of the fibre.

Certain immersion experiments with Sunn Hemp in soap solutions were also conducted and it was noticed that the fibre was considerably softer.

In a description of the retting process of flax (*Linum Usitatissimum*) (3) it is stated that, though for most bacteria the medium should be alkaline, a weak acid solution in the case of flax was found to be satisfactory. It was also found that in the initial stage, retting in stagnant water is caused by aerobic bacteria, after which the action is continued by anaerobic bacteria. To avoid excessive accumulation of acids a small stream of water may be allowed to flow through the dam. A rapid change of water disturbs the retting process. The most suitable water temperature is between 65° F. and 75° F., and when the process is being conducted under warm conditions, frequent tests for quantity and quality of fibre should be made.

In India, the retting practice of Sunn Hemp, is sometimes done in slushy mud, stagnant water or running water, according to the availability of water(1).

Another writer(4) maintains that deep, clear stagnant water is to be preferred. It is also gathered from another work(5) that cleaner fibre is obtained after retting in running water, but the process lasts longer. The last-mentioned writer describes how the fibre is removed by hand by placing the stalks on a rock and beating with a flail, washing out the little pieces of wood and flailing again, after which the fibre is repeatedly flogged in water until it is clean.

Summary.

It was hoped through these experiments to find a method of retting and decortication which would be practicable at a small cost.

After the above-mentioned observations were made with stagnant water, the soaking was continued with slow-running water only. Every time the Sunn Hemp had been sufficiently retted, the bundles were shaken to and fro in the tanks and washed, in order to remove as much of the retted resinous slimy covering as possible, The stalks were then placed erect against strands of wire to dry before being brought under cover for decortication later on.

If the Indian method(5) of washing and decortication is borne in mind, it would appear that attention should be given to the elimination of as much of the cohesive constituents as possible before the stalks are dried in order to obtain a finer and softer fibre.

In practice earth dams may be used for retting when the quantity of water is considerably in excess of the quantity of stalks; also dams for conservation of water for irrigation where there is a gentle in and outflow of water or even pools in rivers, provided the flow is not too strong.

The decortication of dry stalks after machine retting has proved to be economically possible.

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Perosis, or Slipped Tendon in Poultry.

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PEROSIS is a deficiency disease characterised by enlargement of the hock joint; the tendon slips from the hock, followed by twisting turning and bending of the metatarsus (shank). In most cases the chicks cannot move about properly and are often trampled upon by the healthy chicks around the food hopper and drinking water. The result is that growth is retarded and the birds are of no economic importance. Unfortunately the birds cannot be cured.

FIG. 1.—Perosis, or slipped tendon.

Influence of Housing and Feeding.

Perosis occurs more frequently in chicks confined in intensive houses than those on free range. Heavy breeds are, as a general rule, more susceptible than light breeds. It is also possible that chicks may be predisposed to this condition through inheritance. Chicks and young birds may develop this abnormality during various stages of the growing

period. This abnormality has also been reported in day-old chicks which were hatched from hens fed on raw and heated soybean meal in their ration.

It has been conclusively demonstrated that perosis may be caused by feeding rations in which minerals are excessive or deficient, and in which B vitamins are deficient. In this article *various minerals and vitamins concerned in the prevention of perosis are discussed.*

Manganese.

Manganese deficiency in poultry may cause several detrimental effects such as: (1) production of perosis, and (2) ataxia, inferior growth, failure to maintain bodyweight, lowered egg production, decreased hatchability and weak egg shells.

Newly hatched chicks suffering from maganese deficiency show typical ataxia (inco-ordination of the muscles). The head is retracted when the chick is standing or sitting, it cannot retain its balance for any length of time, and finally falls on its back or side. The symptoms last for a few days until the chick succumbs from thirst and hunger. These symptoms should not be confused with vitamin-E deficiency in which case the chicks develop encephalomalacia. The symptoms of this disease are also manifested by ataxia, accompanied by twisting of the head and spasms of the legs. The symptoms develop suddenly and death follows.

Rations low in manganese have a detrimental influence on hatchability, and a high percentage of the chick embryos may have very short and thick legs, short wings, parrot beaks and retarded down growth and body development. There may also be a significant shortening of the spinal column. A large percentage of the embryos die in the shell, and therefore the detrimental effects of a manganese deficient ration cannot be fully appreciated unless the embryos are removed from the egg shells and a careful investigation is made.

In embryo chicks the greatest concentration of manganese in the body occurs on the 9th day of incubation and accumulates rapidly until the 15th day. In newly hatched chicks the manganese content of the body increases rapidly until 5 days of age. On deficient maganese rations the depletion of this mineral in the liver may only occur after 6 weeks of age. A high percentage of chicks will develop perosis on manganese deficient rations during the first 6 weeks, followed by a gradual decline in the number of cases during the later stages of the growing period. This applies especially to practical chick rations is which sub-optimum levels of manganese are included.

The bones of birds suffering from perosis are normal in calcium and phosphorus, but the blood and bone phosphatase (an enzyme which converts organic forms of phosphorus into in-organic) is lower than in normal birds. The bone phosphatase activity of chicks receiving adequate manganese is higher than that of birds suffering from perosis.

The inclusion of sufficient manganese in laying rations cannot be over emphasized. Eggs with stronger egg shells will be produced, a reduction will occur in the breakage of eggs in transit to the market, and the deterioration of egg quality, through evaporation, will be reduced to a minimum. It should be indicated that various other factors also influence egg-shell quality, and it is recommended that birds should be bred for this character and be fed a well-balanced ration.

In various studies the following rations which are known to produce perosis have been fed to experimental groups:

	Rations known to produce Perosis.		
	1	2	3
Yellow maize	40	75½	65·4
Ground wheat	22	—	—
Maize gluten meal	10	—	—
Dried butter milk	10	—	—
Meat and bone meal	10	—	—
Steamed bone meal	3	1	—
Lucerne leaf meal	2½	4	—
Dried yeast	2	—	—
Common salt	½	½	½
Cod-liver oil	2	2	1
Dried milk	—	·14	15
Blood meal	—	1	—
Meat Meal	—	2	—
Dehydrated lucerne	—	—	1
Manganese sulphate	—	—	0·1
Casein	—	—	13
Calcium carbonate	—	—	3
Calcium phosphate	—	—	1

Ration 1 was fed to chicks by Titus, 1932; ration 2 to turkey poults by Nielsen and Madsen, 1942; and ration 3 to turkey poults by Evans, Rhian and Draper, 1943.

It is generally agreed that the manganese requirement of light breeds is less than that of heavy breeds. White Leghorns require approximately 30 parts of manganese, and Australorps 50 parts of manganese, per million parts of food. For the normal growth and the prevention of perosis, chick rations should contain not less than 50 parts of manganese per million parts of ration. For turkey poults the level of manganese may be safely raised to 60 or 75 parts per million parts ration. For laying and breeding hens the manganese content of the ration should at least be equal, or more than recommended for chicks. Higher levels can also be fed if manganese is available at a reasonable price. Where 600 to 1,000 parts of manganese per million parts of ration were fed to chicks no detrimental effects were observed. It is most unlikely that such large quantities will be incorporated in poultry mashes because manganese sulphate (a good source) is in short supply in the Union. Other sources of manganese include potassium permanganate (Condeys crystals) and manganese dioxide or black manganese powder. Condeys crystals can be fed in the drinking water, but it should preferably be grinded to a powder and mixed with the mash. Rations containing high percentages of mealies and mealie by-products should be supplemented with at least ½ lb. of manganese sulphate or potassium permanganate per ton (2,000 lb.) of mash. This quantity will supply approximately 90 parts manganese per million parts of mash. Manganese dioxide varying in manganese content from 12 to 29 per cent. has given satisfactory results when 1 to 2 lb. is incorporated per ton of mash. This product is now being tested at the Institute.

For uniform distribution of manganese in the mash it is necessary that the manganese should first be premixed with other minerals such as bone meal, salt and limestone or oyster-shell powder before being incorporated in the mash.

In the following table the manganese content of various food products are given (Analysis given in bulletin 159 Michigan Experiment Station).

Grain and by-products.	Manganese (parts per million).
Barley	14
Mealies	4·9
Linseed meal	37
Oats and ground oats	36
Soybean meal	30
Wheat	31
Wheaten bran	108
Pollard	100
Animal products :	
Fish meal	41
Liver meal	4·2
Meat meal	18
Bone meal	13
Other products :	
Dried yeast	2·3
Lusern meal	26
Shell	320
Ground limestone powder (average)	280
Rock phosphate	1,250

From this table it will be seen that wheaten bran contains approximately 20 times as much manganese as mealies. Wheaten bran is no longer available for poultry feeding, and hence poultry rations contain a higher percentage of mealies and other grains. This has resulted in a decrease in the manganese content of poultry rations and an increase in the development of perosis in young birds. Ground oats is of definite value in the ration because it contains a higher content of manganese than mealies. Manganese is chiefly concentrated in the hulls of oats.

The absorption of manganese from the intestinal tract of the fowl is small, and is greatly influenced by the amounts of calcium and phosphorous in the ration. More manganese is absorbed under acid than alkaline conditions in the stomach. Chicks require more manganese in diets containing large amounts of calcium and phosphorus, because calcium phosphate prevents the absorption of manganese from the intestinal tract. Rations containing an excess of calcium and phosphorus will, therefore, react as a manganese-deficient ration. The manganese requirement of poultry is also increased in the absence of direct sunlight, i.e. lack of vitamin D.

Poultry will consume an excess of calcium and phosphorus under the following conditions:—

(*a*) When the mash ration contains too much oyster shell or ground limestone powder and bone meal.

(*b*) If the birds consume more mash than grain. It should be remembered that the mash is supplemented with minerals and not the grain.

(*c*) When oyster shell or limestone grit is fed *ad libitum* in separate hoppers and no granite grit is supplied. In the absence of a hard grinding substance, such as granite or flint grit, the birds will consume an excess of calcium grit not only to meet the calcium requirements of the body, but also for grinding purposes. The calcium grit dissolves readily in the stomach, containing a mean hydrochloric acid content of 0·2 per cent. It is, therefore, essential that both granite and limestone grit should be fed to chicks from the time that they receive

growing or laying mash and crushed yellow mealies; that is from 6 or 8 weeks of age. Rearing mashes usually contain sufficient calcium for optimum growth, and hence chicks should only be fed granite grit and no calcium grit until 6 or 8 weeks of age.

Choline.

Since 1940 it is known that choline, a vitamin of the B group, is just as important as manganese in the prevention of perosis. The perosis caused by the manganese deficiency in chicks differs from that caused by choline deficiency in turkey poults, but the external symptoms are similar. The choline requirements of chicks for normal growth are estimated at 100 milligrammes per 100 grammes ration. The requirements of turkey poults may be as high as 190 to 200 milligrammes per 100 grammes ration. The amount of choline in a ration is dependent upon the methioninecystine ratio. The higher the cystine in the ration, the more choline is required. Rations composed of high percentages of wheaten by-products are, as a general rule, low in choline. Good sources of choline are liver meal, fish meal, soybean meal and meat meal.

Jukes, 1940, indicated that an adequate supply of the B-complex vitamins was necessary for the full anti-perotic effect of choline to be exerted. This observation implies a relationship between choline and other members of the B complex.

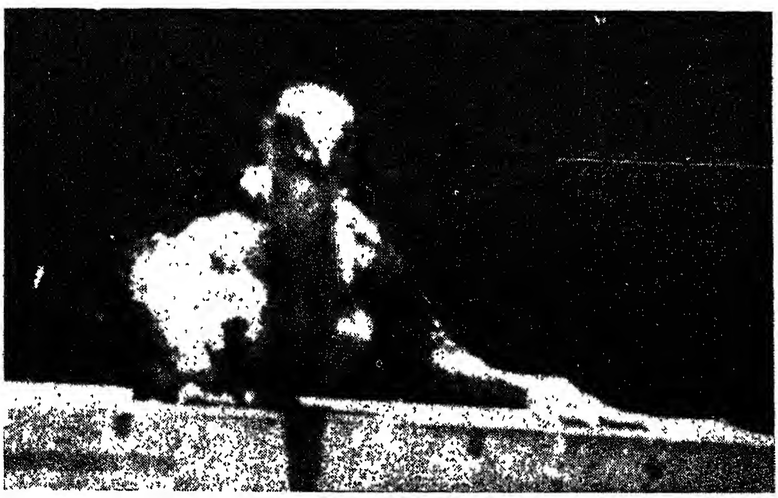


FIG. 2.—An Australorp chick suffering from perosis. Note that the leg turns outward.

Biotin.

It is now known that biotin is also necessary in the prevention of perosis. The biotin requirements of the chick is not high, and such products as kidney, liver, brewers yeast and various other feed products are good sources of biotin. It is most unlikely that perosis caused by a biotin deficiency will occur on practical chick rations containing meat meal, fish meal or both.

Nicotinic Acid.

Nicotinic acid or niacin, also a member of the B group, affords complete protection from perosis. The amount of this vitamin in chick rations will vary according to the presence of the amino-acid tryptophane,

[*Continued on page* 503.

Principles of Grassveld Utilization.

P. J. S. Coetzee, Lecturer in Botany and Grazing Control,
College of Agriculture, Glen.

OUR natural veld is a precious possession, but many farmers still do not appreciate its full value. The tendency still is to regard it as a cheap and inferior source of feed, which neither deserves nor requires any special attention. This contempt for a valuable asset has led to the gradual depletion of our soil cover.

There are approximately 90 million morgen of grassveld in the Union and the systematic utilization of this tremendous source of nutrition is a matter of natural importance.

Farming Systems.

First and foremost amongst the problems in connection with the violation of our precious surface cover is the question of the application of appropriate farming systems. In order to preserve and improve the veld, it is of prime importance that the farming system in any region should be adapted to the vegetation of that region. Failing this, the rapid deterioration of the veld may be expected. We find a striking example of this, where sheep-farming is conducted in regions unsuitable for this type of farming, resulting in injudicious and untimely burning of the veld to provide green grazing for autumn. In this way the vegetation is forced to adapt itself to the requirements of the animal, and deterioration of the veld sets in. To be successful, the farming system must be adapted to the natural environment.

Paddocking of Veld.

Much more knowledge is required with regard to the principles underlying the paddocking of the veld. What for instance is the most suitably sized camp for the various veld types and farming systems? As yet no satisfactory answer supported by experimental data, can be given to this question. The fact, however, remains that in the past incorrect paddocking of the veld was one of the principal factors which has led to the retrogression and uneconomic utilization of the veld. Far more attention will have to be devoted to this aspect of veld control before we shall be in a position to make the best use of our veld.

One of the fundamental principles in the paddocking of veld is the inclusion, as far as possible, of one veld type in the same camp. The inclusion of more than one type of veld in the same camp usually results in overgrazing of one type and undergrazing of the other, during different times of the year.

It is necessary, for example, to separate sweet and sour veld, in order to obviate the possibility of the animals' grazing the sweet veld only, leaving the sour veld portion of the camp to become overgrown and unpalatable.

For the same reason "rantjie" veld which is usually sour, must be separated from flat and vlei veld. Moreover, this will also prevent the tramping out of footpaths by animals going from the higher to lower levels.

The number and size of camps will naturally vary according to the size, veld types and carrying capacity of the farm. The higher the rainfall and the more luxuriant the vegetation, the smaller the paddocks will

have to be. On a sourveld type with a rapid spring- and summer growth, the camps will, for example, have to be smaller than on a sweet-veld type with a lower rainfall.

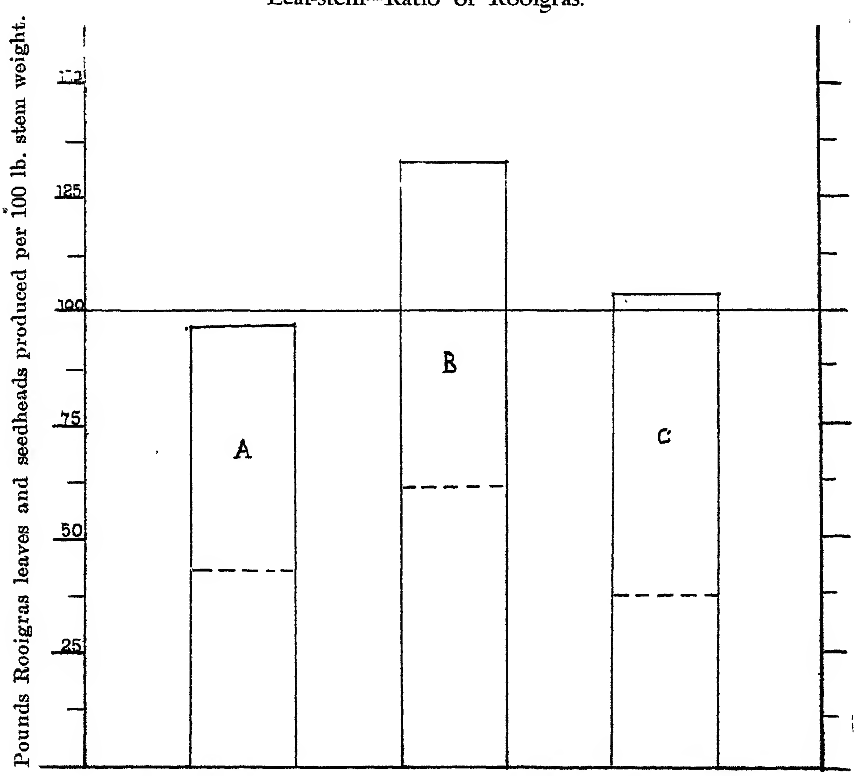
The practical and economic aspects of the matter should, however, be borne in mind, since paddocking, if overdone, might easily lead to unavoidable over-capitalisation.

Systematic use of the mowing machine would, however, effect a great saving in fencing material and water provision. Veld which can be mown may be divided into much larger paddocks than for example veld where, due to terrain difficulties, the use of a moving machine is impracticable. Effective control by the grazing animal alone is most difficult; hence effective utilization, in this case, means much smaller camps.

Use of the Mowing Machine.

There is no doubt about the fact that sufficient use is not being made to-day of the mowing machine as an instrument for veld control, with the result that the general production and carrying capacity of the veld is considerably reduced.

Leaf-stem—Ratio of Rooigras.

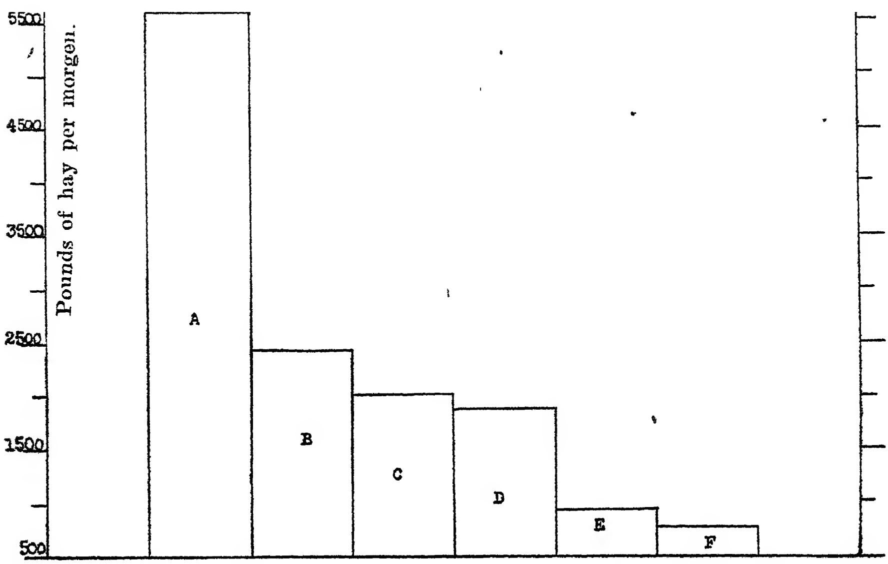


Pounds Rooigras leaves and seedheads produced per 100 lb. stems.
Height of columns to the dotted lines indicate the number of pounds of seedheads.

Column A.—Cut when Rooigras had reached the flowering stage. (7/1/48).
Column B.—Cut when the aftermath again reached the flowering stage. (24/2/48).
Column C.—Cut for the first time. (24/2/48.)

The solution to the winter-grazing problem, as well as to the problem of providing feed during years of drought, may largely be solved by mowing the surplus summer growth and converting it into hay. Every farmer

knows that his grassveld can supply adequate nutrition for the economic production of meat and milk for a few months of the year only. For the rest of the year the animal receives just enough for maintenance, and often not even that. Thus, the importance of and desirability for this step is in direct ratio to the increase in the rainfall and the sourness of the veld.



Hay yields per morgen of different veld types, Glen College of Agriculture, during summer 1947/48.

Total rainfall for growing period to cutting date 14·05 inches. One cutting only.

A. Vleiveld along Modder River. Chiefly *Diplachne fusca.*
B. *Vlei–Rooigras Veld* on camp F. 4 (*c*).
C. *Setaria Nigrirostis* Veld along Modder River. Chiefly *S. Nigrirostis* mixed with *Panicum stapfianum, Brachiaria, Eragrostis* and *Crotolaria* Sp.
D. *Ridgey Rooigras* Veld.
E. *Aristida Vestida* Veld.
F. *Aristida Congesta* on old lands.

Advantages of Veld Mowing.

Apart from the advantages already mentioned, mowing also has a beneficial effect on the maintenance, production and quality of the veld in general.

Experiments at this Institution in connection with the effect of mowing on the stem-leaf relationship of natural Rooigras-veld have conclusively proved that there is a considerable increase in the proportional weight of leaves to stems. A large number of determinations of material, taken the first cutting, have shown that the proportion per weight of leaves to stems was approximately 50-50. Analyses of material from the second cutting indicated that the leafiness of the Rooigras-veld had increased by about 33 per cent. in comparison with the control which was not mown. (See diagram.)

Samples taken at intervals from the control plot showed that the proportion of leaves to stems remains more or less 50-50 if no disturbing factor such as grazing or mowing is introduced. If, however, the veld

has once been cut, a change in this proportion takes place, resulting in a far more leafy veld which will be more valuable for winter grazing in comparison with the veld reserved but not mown.

It was found, too, that the mown veld improved in stand and that there was no deleterious effect in so far as seeding was concerned, provided that the veld was not mown too late and that sufficient growth could take place before winter, for the grass to set seed.

For the sweetveld grass regions it is suggested that the camps reserved for winter grazing be mown for the first time during January or February, depending on the season, or alternatively, be grazed until this time, before being reserved. If the animals are moved from the camp intended for winter use during early summer the winter grazing will become old, dusty, unpalatable and of poor quality.

When to Mow the Veld.

The common practice still is to mow late in autumn. There is no doubt that this practice may affect the veld adversely, especially if the process is carried out repeatedly on the same piece of veld year after year.

It is a matter of common knowledge, that veld grasses retain their nutritive value up to about January and February, according to the season, after which there is a rapid decrease in the nutritive value, more so in the sourveld than in the sweetveld regions. It is clear, therefore, that it is desirable to mow the veld before this deterioration sets in in order to obtain the best hay and at the same time to give the grasses an opportunity of accumulating sufficient reserve food, so that the following spring growth will not be affected adversely.

Mowing in autumn has the further disadvantage that such veld is left exposed for a long period and unnecessary desiccation of the soil may take place.

The best time for mowing veld is therefore as early as possible in summer when the grasses are in the flowering stage or perhaps even a short time before this stage is reached. The younger the grass, the higher will be its nutritive value and digestibility. If, however, grass is cut when too young, the yield will suffer, and it is now generally accepted that the best time for mowing is at the early flowering stage. One or two cuts may be removed during summer, depending on the rainfall, prevailing climatic conditions and veld types of the region concerned. It would, however, be undesirable to remove more than two cuts during the same season, and it also follows that the same camps should not be mown year after year.

It is an irrefutable fact that the systematic use of the mowing machine makes possible the most effective utilization of grassveld, since it eliminates such factors as selective and strip grazing, etc . Without a doubt, the mowing machine is one of the most useful and efficient instruments of veld control, and its value is by no means fully appreciated by most farmers.

Rotational Grazing.

Rotational grazing is another method which may be applied to prevent unnecessary loss of feeding material thus increasing the productivity of the veld. By the application of a system of rotational grazing in conjunction with the use of the mowing machine, the nutritive standard of the natural veld may be raised to such an extent that the harmful results of the periodic droughts which we experience in South Africa could be reduced to a minimum.

It will be found that, where rotational grazing is not practised, the animals usually confine themselves to those grasses originally grazed at the beginning of the growing season. This fact may be readily grasped if we consider that the aftermath of such grazed plants is far more palatable than mature plants. This difficulty arises more particularly when the camps are too large and when there is overproduction of feed during years of copious rain. The outcome of this selective grazing is that only a small percentage of the vegetation is utilized. The remainder of the vegetal cover, consisting usually of the less palatable and inferior grasses, will seed freely and will increase with serious results to the veld.

Many grasses, regarded by farmers as inferior, could be profitably utilized if kept short by a system of rotational grazing which prevents early maturity, and consequent unpalatability. This applies, in particular, to sourveld, which is characterized by rapid spring and summer growth, so that, unless they are kept short, the grasses soon become unpalatable. It must, however, be emphasized, that removals from one camp to another should not be based, as is all too often the case, on the needs of the animals only, but that the needs of the vegetal cover should also receive due consideration.

Veld Burning.

There are few aspects of veld control concerning which so much has been written, and about which there is such divergency of opinion as the question of veld burning. Moreover, contradictory experimental results point to the fact that the question of veld buring as an instrument of veld control cannot be regarded as having been finally solved.

The main obect of veld burning is, in most cases, the removal of the accumulated superfluous dry material. The accumulation of dry material may largely be prevented by using the mowing machine and by applying suitable systems of rotational grazing. The mowing machine cannot, however, be used everywhere, and it is therefore extremely doubtful if veld burning can be entirely eliminated. The correct policy would be to use fire as a means of control only where its use is imperative and dictated by the urgent necessity of removing the accumulated dry material which exercise a smothering effect. Where, however, it is possible to remove such dry material with a mowing machine and to convert it into compost, preference should be given to this method.

In most types of sourveld it is necessary to remove the accumulated dry material at least every 2nd or 3rd year. It has already been proved that if the dry material is removed by mowing instead of burning, such veld is far more leafy and furnishes a larger yield than veld which has been burned.

Where burning of the veld is unavoidable, it is important to give the necessary attention to the management of such burned parts, since the concentrated over-grazing which may occur on such burned portions usually causes more damage than the burn itself.

Time to Burn.

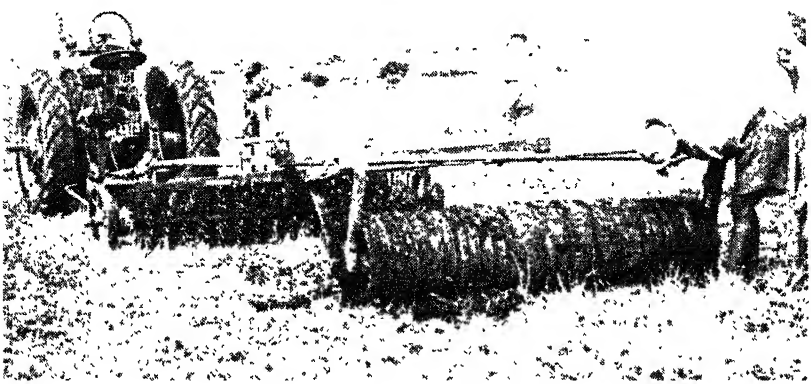
It is always desirable to burn as soon as possible after the first rains, when the soil, as well as the accumulated dry material, is still damp. In this way a hot burn which will injure the roots of the shallow-rooted grasses will be avoided. In no circumstances, however, should veld burning be postponed until active growth has begun, after the rains since, if such young growth which has developed at the cost of the reserve food in the root system is burned, the veld will be seriously damaged.

On the other hand, if the veld is burned too early, that is to say, before the first rains have fallen (July or August), undue exposure of the veld for a long period may result in the event of late summer rains. The result of this will be that considerable drying out and wind erosion will take place.

Grass-burning tests conducted over a period of 20 years at the Cedara College of Agriculture(2) have furnished irrefutable proof that burning during the period of active growth may cause serious deterioration of the veld as well as a very considerable reduction in the density of the vegetal cover. The plots which showed these changes were never grazed and veld burning was the only disturbing factor. Owing to the climate in the region concerned it was only possible to burn the plots concerned every second or third year.

It was also found that veld burned in March, i.e. at the end of the growing seaon, showed the same degree of ousting of Red grass by poor quality pioneer grasses and weeds.

Autumn grazing on this burned veld resulted in all cases in an acceleration of the process of retrogression.



Reclamation of trampled-out veld by introduction of seed of better veld grasses.

Whether these results are applicable to other sourveld regions is not known. It is doubtful, however, whether veld burning during the period of active growth, as well as during the autumn, to afford green grazing for sheep, can benefit the veld at all, especially when such burning is followed by the customary heavy, concentrated overgrazing of the green portions.

Grazing Systems.

Any grazing system should be elastic to be successful in practice, and removals of cattle from one camp to another cannot be regulated according to the calendar.

Grazing conditions vary from one type of grassveld to another and virtually from farm to farm; consequently, no such thing as a definite grazing system applicable to an entire region can be formulated. Much information in connection with the appropriate grazing systems for different veld types may be obtained from the Agricultural Research Station serving your region. Sufficient use is not made of the information already available.

It is desirable for the farmer to have a thorough knowledge of the vegetation as well as the fundamental principles of effective veld control. This knowledge will often enable him to plan control methods to fit in with his local conditions. Involved grazing systems which are based on the arm-chair conception of veld control and which break down as soon as applied in practice must be avoided.

CONTROL OF DIFFERENT TYPES OF GRASSVELD.

Sourveld.

There are quite a number of types of sourveld usually found in high rainfall regions. It may be stated, however, that practically all sourveld types are characterised by rapid growth during spring and summer accompanied by a rapid decrease in feeding value and palatability as the plants reach maturity. Sourveld is therefore not suitable for winter grazing, since chemical analyses have shown that the grasses in some sourveld types contain as little as 1 per cent. protein during the winter months. The period of utility of sourveld is usually short and the growth luxuriant. The methods of management of sourveld should therefore be based on the abovementioned characteristics.

It has been established(3) that the best increase in liveweight is obtained on sourveld by following a system of rapid rotational grazing during spring and summer. By applying this method the sour grasses are prevented from maturing and becoming unpalatable while only the sweet grasses which may appear in such sourveld, are grazed.

Sourveld should also be grazed as early as possible in spring. A rest in spring, followed by summer grazing, is disastrous to sourveld, since selective grazing is encouraged and the veld will become still more sour.(4)

The mowing machine is indispensible for the effective control of sourveld since sour grasses have good nutritive value, if kept short.

For the effective control of sourveld, it will be necessary to keep the grazed camps short by the application during spring and summer of a system of rapid rotational grazing, in conjunction with a programme of preserving the surplus summer growth in the form of hay which may be utilized during winter when the veld is almost useless. This system produced excellent results at the Athole Experiment Station in Eastern Transvaal and further information may be obtained from the Officer-in-Charge.

Sweetveld.

Sweetveld grasses retain their palatability and nutritive value after the mature stage has been reached and such veld is therefore more valuable for winter grazing than sourveld. Sweetveld regions usually have a lower rainfall, and leaching does not take place to the same extent as in the case of sourveld and the growth is comparatively slow during spring.

As in the case of any other type of veld, sweetveld should be rested periodically. The number of camps annually withdrawn for resting will naturally depend upon the rainfall. The higher the rainfall, the larger will be the number of camps which may be allowed to rest and seed. In general, it may be said that each camp should be rested and allowed to seed during summer and autumn at least every fourth or fifth year. Such a camp is then grazed during winter to effect the trampling in of the seed and again allowed to rest during the following spring and early summer for ensuring the establishment of the young grass plants.

Where a farmer has a limited number of camps at his disposal, rotational grazing may be applied to all camps until January or February. By this time the camps intended for winter use should, however, be vacated and the stock concentrated in the fewest possible number of camps, so that the maximum number of camps may be rested for winter grazing and seed production. By concentrating the stock every year during the rainy season in different camps, each camp, in turn, will be given a reasonable chance to seed. In contrast with sourveld, a period of rest in spring is most important for sweetveld and it will therefore also be be necessary to spare the camps in rotation during spring and early summer in order to protect the young plants against grazing. Veld vacated in January or February will, in most sweetveld regions, still yield a full seed crop during years of average rainfall.

Some farmers prefer to rest camps for a year but this perhaps causes unnecessary loss of valuable grazing, since the mature grasses are unpalatable and not worth much as winter grazing.

Mixed Grassveld.

On mixed veld a mixture of sour and sweet grasses is found and consequently such veld retains its nutritive value to a certain extent during winter.

Mismanagement of mixed veld sometimes results in the veld becoming sour on account of the destruction of the sweet and more palatable grasses.

It is clear therefore that the mowing machine should play a very important rôle in the effective control of mixed grass veld.

Since there are usually some sour grasses present, it is necessary to graze the veld heavily during summer to prevent selective grazing, the destruction of the more palatable grasses and the increase of undesirable types(5).

At the Towoomba Agricultural Research Station(6) it was found, however, that rapid rotational grazing on decidedly mixed veld was not successful in preventing selective grazing of the sweeter varieties and that it was necessary to use the mowing machine to control such veld.

Sheep on Grassveld.

Effective veld control with cattle in grassveld regions is comparatively easy in comparison with the methods of control which must be applied where such grassveld is grazed by sheep alone or by cattle and sheep simultaneously.

Sheep grazing experiments(7) conducted at the Glen College of Agriculture, showed that none of the grazing methods applied effected the desired improvement of the veld. It also appeared that a heavy concentration of sheep for a short period, followed by a comparatively long period of rest, caused the least damage to the veld while at the same time giving the highest carrying capacity. Furthermore, it was found that the longer the grazing period and the shorter the periods of rest in between, the more harmful was the effect on the veld, with a correspondingly lower carrying capacity. With continuous grazing, damage to the veld was at its highest level.

To manage grass veld in such a way that it is not impaired, and at the same time to safeguard the interest of the sheep, is no easy task. The sheep-farmer wants short pasturage of high nutritive value throughout the year. How to comply with these demands without causing veld deterioration, is a problem to which as yet no complete solution has been found.

It is known that cattle can make better use of grassveld, and the solution of effective grassveld management in so far as sheep are concerned, may perhaps be found by determining the basic sheep—cattle ratios for every specific veld type. It goes without saying that this ratio will vary greatly from year to year even on the same veld type. If, however, we are able to establish a basic ratio, it will mean, in practice, that during favourable years, the farmer will have to concentrate all stock on a portion of his farm and rest the maximum number of camps. During dry years, if necessary, the whole farm may be utilized for grazing. The higher the rainfall and the more luxuriant the growth, the smaller will be the number of sheep in relation to the number of cattle which can be grazed without damage to the veld.

Sheep farming is an important established industry in grassveld regions of this country and research which will lead to the solution of this problem is urgently required.

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(4) Must Sourveld rest during Spring? J. P. Botha. *Farming in S.A.* November, 1945.

(5) Veld Management in Southern Transvaal and Northern O.F.S. *Farming in S.A.* January, 1946.

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Methods of Fertilizer Application for Tobacco:—

[*Continued from page* 460.

As regards the effect of the treatments on the germination of the seed, it can be concluded that the " band " method gave the best percentage of germination, and that the planter method (seed in contact with fertilizer) was most unsatisfactory. The quantities of artificial fertilizer did not have any marked effect on the germination.

The " band " method is largely superior to the other treatments in so far as the yield is concerned, giving almost 5 bags per morgen more than the next best treatment. A small quantity of fertilizer—300 lb. per morgen—applied according to the " band " method gives a yield of 3·5 bags more than the large quantity, viz., 900 lb. per morgen sown by the planter method, (compare D1 with C3 in table VII).

The yield per morgen increases in direct proportion to the higher quantities of artificial fertilizers applied.

The most striking result of this experiment on maize is the high percentage of germination and yield of grain consequent upon the " band " method of application and although this finding is based on the results of one season, the high opinion held by so many research workers for the " band " method does seem to be justified.

The Bridge Weir in the Tarka Conservation Area.

Roscar du Toit, Officer-in-Charge, Tarka, Conservation Area.

Annually large numbers of bridges are built across dongas, and spruits. These bridges fulfill *one* function only, namely the facilitation of transport across our roads. The Division or Soil Conservation feels, however, that each bridge could serve a more useful purpose if it were to fulfil a dual function, viz. transport facilities and soil conservation. With this in mind, the bridge weir was built in the Tarka Conservation Area for demonstration purposes.

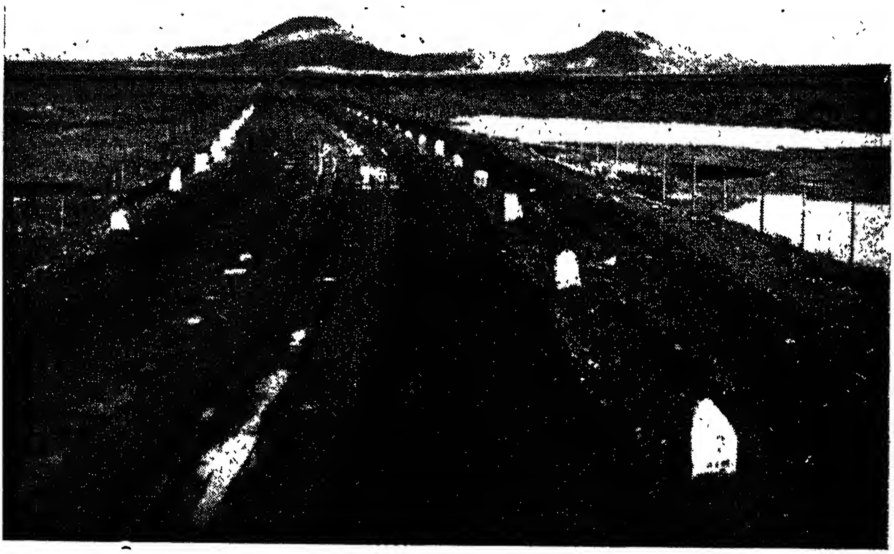

FIG. 1.—A view of the bridge and weir traversed by the road.

As can be seen from the accompanying snapshots, it is an ordinary bridge against which a weir has been built. The bridge furnishes the transport facilities, and the weir acts as a catchment area for silt, and so conserves the soil. As the donga is silted up, drainage is reduced, the original surroundings re-created and the water table (for a better plant cover) restored.

The bridge weir in question was silted up with the first summer rains. Already the silt has been planted to common reed and by next season we will have a vlei there in the place of the barren donga. Note the appearance of the dongas when viewing the bottom of the bridge (Fig. 4) and compare this with the silted-up portion above the weir. (Fig. 3).

The bridge was built according to specifications laid down by the Provincial Administration and the costs involved were £450. 2s. 0d. The weir attached to the bridge was built of cement bricks (1:6) at a cost of £128. 10s. 10d. Thus, the total costs were £578. 12s. 10d. which, in the circumstances, were very reasonable.

It must be borne in mind that this structure is merely a demonstration, and that cheaper structures could be set up if the undertaking were tackled on a large scale. In the Tarka Conservation Area, it has, for example, been found cheaper to use concrete than cement bricks. Here the weir portion was built of bricks for the very reason that (for demonstration purposes) and special design did not justify the costs of specific concrete forms.

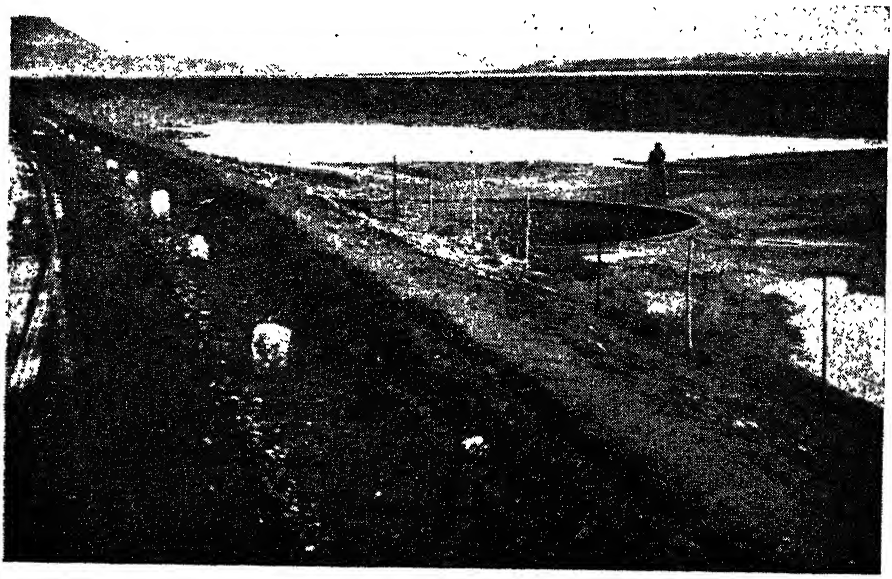

FIG. 2.—The donga around the weir (right) almost silted up.

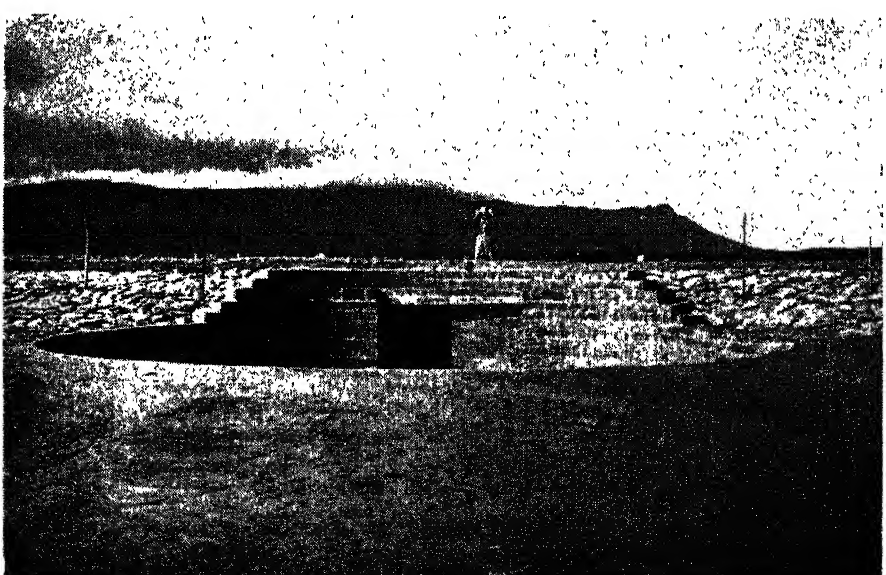

FIG. 3.—The silted up donga around the weir.

In most bridges water is found to concentrate near the structure, and consequently further erosion of the donga or river lower down is accelerated. The obstruction of the velocity of the water on the underside of the bridge (whether or not there is a weir) is therefore very important.

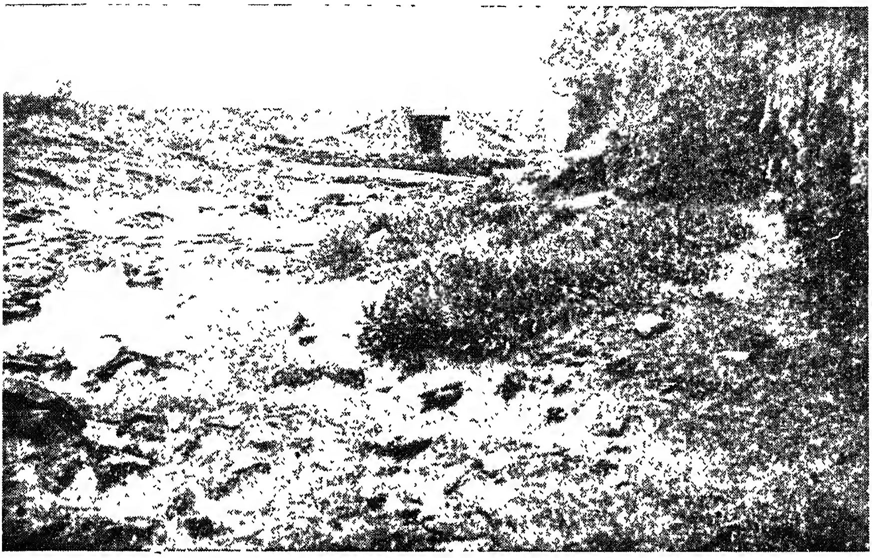

FIG. 4.—The underside of the bridge weir. Note the depth of the donga. The little stone walls retard the velocity of the water.

As indicated in Fig. 4, provision has already been made for this—by a series of stonewalls—albeit very primitive. Improvements will be effected in this sphere, adapted to the specific locality. It must be clear that each area presents its locality. It must be clear that each area presents its own problems and should therefore receive special attention from suitable qualified persons. The passage below the bridge, the edges of the weir, the catchment area and the average precipitation,—all these are vitally important factors which should be taken into account for every donga and every locality.

In conclusion, it may be stated that, upon completion, this structure was admired and approved by the Engineer of the Provincial Administration.

Useful Bulletins.

The following are a few of the bulletins obtainable from the Editor of Publications, Department of Agriculture, Pretoria, post free and prepaid at the prices indicated:—

Poultry Farming.—Bulletin No. 241, by Dr. J. J. Bronkhorst. Price 1s.

Poultry Houses.—Bulletin No. 257, by C. L. Marais and N. J. van Straaten. Price 1s.

Turkeys.—Bulletin No. 264, by E. F. Lombard and Prof. A. M. Gericke. Price 3d.

Pasture-Research Objectives for the Semi-Arid Regions.

Dr. J. W. Rowland, Principal Pasture Research Officer, Division of Agricultural Education and Research.

"TO gain control of the soil is one of the greatest achievements of which mankind is capable". This is the opening sentence of the book "The Rape of the Earth", and, no doubt, many of you have read it. It is perhaps beneficial for research workers from time to time to take stock of achievements and check compasses to see if they are set well and truly towards the control of the soil, and to survey the land and the roads ahead of us.

Such stocktaking makes possible also a survey of certain aspects of pasture work on which clarity of thinking is particularly necessary at the present time.

Pasture research has never fitted comfortably into any particular compartment, in that it naturally mingles with animal research, it often deals with crops and soils, is tied up with erosion control and engineering, and is intimately connected with botany and ecology. It lies at the heart of soil and veld conservation, in that veld management is the main means whereby much of the enormous run-off and siltation may be checked. Perhaps it is reasonable to say that any plants with animals grazing on them may be regarded as pastures. Plants and veld can scarcely be regarded as pastures unless there are animals grazing them.

A Soil-Plant-Animal Balance.

The hard core or root of the problem of soil conservation is our failure so far to achieve a soil-plant-animal balance. We have a certain area of land and soil in this country, and a certain number of animals and people. We have periodic growth and dormant periods. We must store in the growth period the surplus growth for the dormant period. We have a certain standard of nutrition which must rise and not decline, and our demands from our land must increase correspondingly. Our problem, therefore, is to achieve for the country a production of our food needs, and this entails a pasture and fodder programme for the livestock that food production demands. If we hope to remain in this country, we must do this without having to resort to soil depletion, while the necessity for food imports and exports can be adjusted accordingly. To-day we are failing signally to fit our farming to the basic needs of the soil and vegetation for the maintenance of livestock, and we are also failing to feed our people adequately.

That is, our soil-plant-animal relationship is unbalanced. How can we approach this basic problem? The commonly accepted scientific approach is the analytical one. We must increase production and quality per unit of area, and crop and animal: we must find systems of veld management whereby the veld is used without being destroyed, and we must find methods of plant and water stabilization on erodible soils. Each individual engaged on research takes one or other of these aspects and tries to find an answer to the particular problem. But still the soil-plant-animal complex has to be balanced, and in all to many cases this delicate task is left to the farmer himself.

This is a controversial point, but it merits some consideration. The time has come when we need some means of approaching the problem of the soil-plant-animal balance synthetically; this in contrast to the analytical approach. The method to hand so far is the unit experiment, which is being carried out in different forms under various names, such as co-operative experiments or demonstrations, whole-farm demonstrations, beef units, dairy units or breeding units, and veld-arable units. All are similar in general approach, are more or less complex, and more or less closely approach actual farming conditions.

Uniformity and Continuity of Production.

For the preliminary exploration of the soil-plant-animal balance, all the frills and everything unnecessary must be eliminated. For the achievement of this balance ,we do not need new crops, nor new and improved animals. We need to poise this balance with the crops we have now, with our present knowledge of soil-fertility maintenance and veld and pasture management. If for each major set of conditions we can achieve for livestock a continuity of feed of a definite standard by the successive grazing and utilization of veld, pastures and forage crops; if we can tabulate and understand a proper crop and pasture and veld sequence to provide uniformity of cheap feed in continuity throughout the year; if we can couple these with soil stability, then we have a hard core of knowledge on which the refinements of individual farming practice can be built. Save for a very few local exceptions, that core of knowledge does not exist, and sectional research by itself will not attain it. That is, a new crop discovery, or a better or more suited form of livestock, or improved quality of crop and animal produce will not contribute in this at all. Further, on a research station, the laying down of one or even two elaborate farm system units will be a case of placing the cart before the horse—the elaborations can be added after the main design has been put together. That main design of conservative land-use is not in the compass of our knowledge to-day, save in very limited areas. We need this main design to have on each major type of country a substantial number of highly simplified units in which a soil-plant-animal balance is sought. The constant and unchallengable data in these seekings are the climate and the soil potentialities, and for each unit a particular degree of pressure must be exerted on the land. By this is meant that on one station and one soil type we need to start a series of land-use or soil-plant-animal balance units, one of which has to support, say, an animal population pressure of one head of cattle to four morgen; another unit with an animal population pressure of one head to two morgen, and another of one to one morgen or less. What cropping sequence has to be employed, and what percentage of the total area has to be crops to achieve this increase? What is a suitable system of veld and pasture management to balance an area proportion of, say, one crops to nine veld, or four crops to six veld, or six crops to four veld? For an area which is entirely ploughed and in which crops and leys must alternate within themselves, our knowledge of ley rotations is slight indeed.

To go further, each station needs to serve its soil and climatic type under different economic circumstances. These include native areas with a high number of humans and a heavy stocking rate of livestock per unit area; and European areas, where the human and animal population are under very different conditions and proportions. On some research stations, particular farming systems applicable to-day are being worked out on units of considerable size. This is work of the greatest value, but there is also something to be said for a more

comprehensive although a more modest approach on highly simplified lines to the problems arising at a number of levels of intensification of land use. The ratios quoted above are given by way of example. Obviously ratios should be chosen that are reasonably possible for the climate and soil involved.

To go further, the class of animal to be kept on these simplified units is a constant source of discussion and confusion. For instance, under an extensive system of pure veld-management with no arable supplementation and regular consumption of plant production, the live-weight gains give a firm indication of ration quality from season to season and year to year. Under a more intensive unit in which crops take a part, it is immediately obvious that more productive animals than steers can be used. But the smallnes of the unit is a difficulty. A breedind herd or a milk herd is impossible to simulate if the herd-size is three. On the other hand, costs render impossible the running of six or twelve large dairy unit experiments under any basis of comparison. If, however, steers are used throughout, surely the live-weight gains and the analysis of feed available at different seasons will provide a guide as to whether the system can carry something above steers. A unit, for instance, which provides feed of such a quality that young steers can gain steadily more than two pounds in weight daily for the whole year is obviously one which can be considered for a dairy proposition. The dairy part of the business can then be superimposed on the ground work which is a stable well-managed veld, a cropping sequence with perennials and annuals, and knowledge of the relative areas of each and uses of each. Our *lack* in knowledge in general is that sequence of crops and pastures, the management of them, and the management of the veld at the stocking rate which the forage available and ratio of arable land to veld must impose.

Rotation Management in Land-use.

The Division of Soil Conservation is faced with the working out of farming systems in each area for each farm. The knowledge they need to-day is not so much a better maize plant or crop, rather is it a basis of rotation management for a particular intensity of land-use. This information can largely be obtained by such small, highly simplified units, running side by side and sumultaneously. If such rotations and sequences could be discovered to apply to different degrees of intensification of land use—in other words, if an area could be understood and a basis of soil conservation achieved at a level of production such as dry-veld grazing, and a higher level of production, such as veld plus a little cropping, and an intensive level of production, such as cropping plus a little veld; if these degrees of land-use intensity were correlated with carrying capacity and with costs and quality of feed produced, it could be a relatively simple matter for the field services to fit a suitable type of livestock and cash crops. Once in possession of data on these lines for different regions we are in a position to interpret them in terms of that complex entity, a farming system. This knowledge in large measure we lack to-day.

We are still pursuing sectional academic research on many lines and we have solitary units which in themselves are exploratory and in which we have had the temerity to fit exacting and difficult livestock management. The large areas involved in such highly specialised units preclude the approach to the land-use problem *per se*, and under these circumstances the experiment is diverted from the basic problem of land-use to the refinements, although the basic problem should be under scrutiny in its own right.

Experimentation on these lines may be expected to open the doors once more to specialist research activities on a vastly more effective basis than hitherto. It will enlist the efforts of the agronomist on pasture and crop and seeding problems for which the standard agronomic technique is pre-eminently suited. It will stimulate the research for types of animals to fit the nutritional planes achieved, and will make possible the designing of effective animal experiments on systems of land-use which in themselves have been proved to be stable. To-day so much complex animal-production work is carried out, either on veld which is so lightly grazed that the animal-production side is uneconomic, or on systems in which the veld management and cropping and ley systems are not even known to be stable.

We should approach first problems first, and, give close consideration to the immediate needs of the Division of Soil Conservation, which are these basic facts of rotation and stability of soils and veld, and the nutritional levels achieved and the cost of each degree of intensification.

Accusations have been made that this form of work is unscientific. We have seen the effects of synthesis in the Conservation Services. They are dragging together the genius and knowledge of all sections into a farming plan for each farm and for the whole country. This has been made possible by a breaking down of sectionalism, by a turn from the analytical and sectional approach and its replacement by a synthetic approach to farming and to the farmers' basic problems. The need for immediate action calls for such a move, however, incomplete as our present knowledge may be. Necessary support will, it is hoped, come from effective research which also meets to-day's problem to-day, by viewing the land-use problem as a whole, *in vitro* as it were, in highly simplified land-use units. These will give the basis for land-use at different intensities and will yield a wealth of research problems for specialist experimentation from the very moment of their inception.

The main theme for planning is concerned with the question of payability of farming. Most unit experiments are largely concerned with this aspect, but the actual payability of systems of farming can be dealt with through economic adjustment. In the Pasture Research Progress Report No. 2, the following appeared:—

" The research must ultimately aim at a balance between the removal of plantgrowth from the soil and return of plant and animal residues to the soil.

With the exploration of these points, it would be refreshing to see the ingenuity of the economist directed towards the framing of laws, tariffs and subsides for soil preservation. Measures whereby soil building and fertility conservation may not only become economically possible, but be richly rewarded; whereby also destructive farming methods may become economically unsound and lead its adherents to bankruptcy".

We know that soil conservation will be expensive, but it is reasonable to expect that *farming systems* will save the soil in the long run, aided by engineering works.

In the first instance, therefore, we need lucidity and clear thinking in this matter. Soil conservation we must have first and now. High farming or intensive farming is not the only answer. Stabilization must be achieved at all levels of intensification, anywhere. If our methods are costly, and our rotations are proved to be costly, it still is irrelevant; dam building and contouring are also costly. At least we will know

that the land-use is right. The reduction in costs of conservative farming will come with new crops, heavier yields, cheaper fertilizer methods, and more suited and better livestock. These are subjects for specialist research.

These suggestions in no way challenge the specialist work which falls naturally within established academic categories. In the existing organization of this Research Division contacts with other sections are stimulated, and conditions for this specialist work are extraordinarily good.

More Effective Co-ordination of Research.

But there is such an immediate need for the exploration of the soil-plant-animal balance in its own right for the present requirements of the soil conservation programme, that the country can scarcely afford to give it a minor place. Our research stations are few, although they are widely scattered. Perhaps it would be possible to amplify our station researches by sponsoring a series of these highly simplified units throughout the different regions under the immediate direction of the Field Services. This type of synthetic research is needed by every conservation officer who is faced with the task of working out a farming plan, whether it is for an isolated farm, or for a district. If this work is not started, basic needs of knowledge will not be coming forward in massive evidence, but as incidental fragments hanging on to specialist research.

Technicians are still not in agreement as to the potentialities of the different regions of this country for intensification of land-use. Palestine, Greece, and North Africa have achieved highly intensive land-use under incredibly difficult soil and climatic circumstances. Our beautiful country is so lightly stocked, so empty, and yet our land-use is destructive, on the extensively farmed areas almost as much as on the more closely populated areas.

A botanical survey has been in progress for many years and a new map is in course of preparation. We know our global food needs in the Union; we can work out our bulk forage needs and concentrate feed requirements. Is it not time that the ecological maps of the Union be correlated with these needs and that not only farm plans be worked out, but regional plans of agricultural production in relation to other regions and in relation to the Union's food needs as a whole?

Great power is vested in the Regional Offices, and within themselves a goal of so much food, so much feed, so much produce to be sold outside the region might be worked out in broad principles, so that farm planning could be orientated within the Union-wide framework. Where must intensification of land-use take place? In the high-rainfall sour areas, or in the rich maize country? To what degree is intensification desirable in the drier parts? These research units can do much to help in co-ordinating such a plan.

The conservation areas present problems of re-seeding, revegetation and grazing management which merit a wholehearted research effort. The forestry area grazings present specific veld and water conservation problems. The need for research in land use and conservation calls for the welding together of a team at each research centre to approach the soil-plant-animal balance in the European areas, in the Native areas, in the conservation areas and in the forestry area grazings. To-day men are working independently on this problem in the Forestry Department, the Native Affairs Department, the Department of Education and Social

Welfare, as well as in the Department of Agriculture In this Department alone, workers in this field are at universities, in the Division of Botany, in the Division of Soil Conservation and Extension, as well as in the Division of Agricultural Education and Research.

Within the latter Division progress has been made towards the formation of a team on each research centre to attack the land problems as a whole, and a close liaison already exists between this Division and the Division of Soil Conservation. The Departmental, Institutional and Divisional barriers make close teamwork difficult. Quite apart from this, the working out of a common meeting ground, even among the research specialists, takes time. A broad highway of land-use and conservation research has yet to be opened up. The territory is virtually untrodden, but a comprehensive and determined advance by the nucleus that can be formed within this Division at each centre may do much to draw together and enlist aid from interested bodies.

I believe that a facing up to the need for synthesis in land-use and conservation research will be a meaningful and real service to the country, and will make it possible for the agricultural scientists to view more clearly their objectives, and the completeness (or rather incompleteness) of their present work.

Perosis, or Slipped Tendon in Poultry:—

[*Continued from page* 485.

which is present in animal protein such as fish and meat meal. Some investigators consider that 2 milligrammes of niacin per 100 gramme ration give satisfactory growth and complete protection from perosis. It is entirely possible that this quantity may be too low when rations containing high percentages of mealie meal are fed. In experiments at this Institution good results were secured when chicks received rations containing approximately 5 to 7 milligrammes niacin per 100 grammes food. Excellent sources of niacin are liver meal, brewer's yeast, peanut meal and wheaten bran. The synthetic products costs approximately 16 shillings per lb., and about 3 grammes per 100 lb. mash can be included in high mealie-meal rations.

Riboflavin.

This is an important vitamin of the B group. It prevents curl-toe paralysis and is essential for normal growth, egg production and good hatchability of eggs. McGennis and Carver, 1947, indicated that turkey poults fed on a diet composed of natural ingredients but containing no riboflavin-rich materials grew poorly, developed severe dermatitis, a high incidence of perosis, and were poorly feathered. These symptoms were largely prevented by supplementing the diet with dehydrated lucerne and riboflavin.

Chick rations in the Union consist chiefly of mealie meal, maize-germ meal, ground oats or ground barley, lucerne meal, fish meal or meat meal and peanut meal supplemented with minerals. These rations are low in manganese, nicotinic acid, pantothenic acid and riboflavin. By supplementing these rations with manganese sulphate or some other source of manganese and dried brewer's yeast the occurrence of perosis can be reduced. One should also make quite certain that the phosphorus content of the chick ration should not exceed 0·9 per cent. and the calcium 1·8 per cent. The fact that the ration of breeding hens may have a definite influence on the development of perosis in their chicks is an important reason why one must feed a well-balanced breeding ration.

Information on Departmental Publications.

Farming in South Africa, the monthly journal of the Department, contains popular as as well as scientific articles on a variety of agricultural topics, useful to both the farmer and the housewife, while the Crops and Markets Section supplies information on crop prospects, market prices and exports of agricultural produce.

The following particulars in regard to subscriptions and advertisements should be noted —

Subscription.—Within the Union, South West Africa, Bechuanaland Protectorate, Southern Rhodesia, Swaziland, Basutoland, Mocambique, Angola, Belgian Congo, and British Territories in Africa, 5s. (otherwise 7s. 6d.) per annum, post free, payable in advance.

Applications, with subscriptions, to be sent to the Government Printer, Bosman Street, Pretoria.

Advertisements.—The Tariff for Classified Advertisements is: 2d. (two pence) a word with a minimum of 5s. per advertisement (prepaid). Repeats, not entailing any change in the wording, will be published at half the cost of the original.

Conditions:

(1) The advertisement will be classified under specific headings, and only one black letter (initial letter) is permitted.

(2) Advertisements in which prices are mentioned must contain the name and address of the advertiser. A nom-de-plume or box number only is not sufficient, and unless this condition is strictly observed, advertisements will not be accepted.

(3) Advertisements will be classified strictly in accordance with the subject-matter of the announcement, determined by the first item mentioned and cannot be inserted under irrelevant headings.

(4) Displayed, classified advertisements will also be accepted. The charge, however, will be 10s. per inch, single column, per insertion, without reduction for repeats.

Copy for Advertisements to be in the hands of the Government Printer, Pretoria, not later than the 20th of the month preceding publication.

Send all advertisements direct to the Government Printer, or write to him for details as to tariff for advertisements.

Popular Bulletins.—Bulletins on various agricultural topics are published by the Department to meet public demand. A list of available bulletins giving particulars of cost, etc., is obtainable free of charge from the Editor, Department of Agriculture, Pretoria.

Scientific Publications.—From time to time the different Divisions of the Department issue science bulletins incorporating the results of research work conducted by them. Other scientific publications issued are: "The Onderstepoort Journal", "Memoirs of the Botanical Survey of South Africa", "Bothalia", "Entomological Memoirs" and the "Annual Reports of the Low Temperature Research Institute". Information in regard to these publications is obtainable from the Editor, Department of Agriculture, Pretoria.

Press Service.—The Press of South Africa is now supplied with a bulletin of agricultural information for their exclusive use. This information is supplied to all newspapers and other journals throughout the country.

Farmer's Radio Service.—In addition to the printed information supplied by the Department to members of the farming community, the Department, in collaboration with the South African Broadcasting Corporation, also has a national broadcasting service for farmers. Information in regard to times of broadcasting is contained in the programmes issued by the Broadcasting Corporation.

Inquiries.—All general inquiries in regard to the above should be addressed to the Editor Department of Agriculture, Pretoria.

D. J. SEYMORE Editor.

CONTENTS

NOTE.—Items marked with an asterisk (*), are papers read by professional Officers of the Division of Agriculture Education and Research at a Conference held in Pretoria, and referred to in an Editorial in the July issue of " Farming in South Africa."

[*Photo on Cover*: An Irrigation Scheme near Kimberley.]

G.P.-S.4038—1948-9—8,250.

FARMING IN SOUTH ... AFRICA

VOL. 23 AUGUST 1948 No. 269

Editorial:

Ensuring the Future Prosperity in Fruitfarming.

WHILE there is no cause for pessimism with regard to the future of the deciduous fruit industry, symptoms of unhealthy development are not wanting. As after World War I, high and even fancy prices are being paid for land under the stimulus of the remunerative prices obtained for export fruit during the past two seasons. In some instances it should be exceedingly difficult to obtain a fair return on the capital outlay, even if present price levels were to continue for some time. In others, any marked recession will at once lead to uneconomic returns. As before, sub-division of farms into uneconomic units is also in evidence.

There is also the same impetuous rush to plant every possible morgen of land. Reputable nurserymen supplying reliable plant material are fully booked up with orders for the next two or three years for certain varieties. There is, regretably, also a flourishing trade of considerable proportion in material of questionable origin and worth, so insistent and impatient is the demand. Risks are being taken in regard to vines from "vlamsiekte" areas and "varieties" from "factory"-seed which no ordinary gambler would take. Surprisingly enough, it is often the established grower who will take these risks, not the newcomer to fruitfarming.

One would have thought that the bitter economic results of the many unsound plantings during the decade after the 1914-18 war would be very well-remembered—the struggling years after 1930 to the beginning of the present war, when the proud and independent fruitgrower had at times to depend on a government subsidy! In these and especially during the critical war years, the many inherent weaknesses of the fruit industry became only too apparent—the large acreages, planted with varieties not suited to the particular local climatic conditions, with resultant troubles such as delayed foliation and irregular bearing, the uneconomic yield from orchards established on the wrong type of or on marginal soils, the poor keeping quality of many varieties, the great variations in yield due to trees of diverse origin and on unsuitable rootstocks and the poor organization of plantings. Although force of circumstance has resulted in the elimination of the more glaring weaknesses, many are still present, and merely masked for the while by the good returns. Many a grower must now be wishing that he had got rid of his low-yielding plantings long ago and been able to take advantage of the present remunerative prices by virtue of young and vigorous trees!

The post-war fruitgrower of to-day is in a far stronger position than his confrere was after the previous war in safeguarding his future and ensuring a good measure of prosperity, even with a recession of fruit-prices. On the face of it, the long-term prospects of the deciduous fruit industry seem to be far brighter to-day than during the past twenty years. Fruit is no longer regarded as a luxury but as an essential part of the ordinary man's diet to supply vitamins and minerals in their most palatable form. Promoted also by high wage levels, consumption per capita is apparently increasing in this and other countries. Due to the

limited areas of soil still left which are suitable for fruit-production, there is less chance for too rapid expansion than after the previous war, and far too wide a gap between production and consumption. With the development of new mining areas and increasing industrialisation not only in the Union, but in the Rhodesias and other African territories, an increasing demand for fresh fruit seems likely. The processing industry has made vast strides, and is utilizing a growing volume of fruit to cater for the demand for tinned foods, which urbanisation inevitably entails. Furthermore, the present-day fruitgrower is doubly blessed in that he not only has a central marketing organization, born out of the emergency of war and perfected through a number of crises, but also an adequate technical service provided by the Department of Agriculture to serve his every need.

The rest is up to the fruitgrower himself. He has every opportunity of starting right with his new plantings—the correct variety for the particular locality and for his type of soil, which is the foundation of high yields and good profits, even when consumers' purses are shorter. Now is also the time for the established grower to ensure prosperity in leaner times by removing ageing and uneconomic trees and vines, and to orientate his plantings in the light of changing market trends and new developments in research and breeding work.

It would be foolish to ignore the many indications of declining prices for fruit and fruitproducts, and not to plan accordingly.

(Dr. R. I. Nel, Western Province, Fruit Research Station, Stellenbosch.)

An Agro-Ecological Survey of Natal.

A very informative bulletin, by Mr. J. A. Pentz, Officer in Charge of the Drakensberg Soil Conservation Area, has recently been published by the Department under the title An Agro-Ecological Survey of Natal. (Bulletin No. 250.)

This bulletin should prove of the utmost value to all field officers of the Department of Agriculture, students of agriculture, members of committees of soil conservation districts and to farmers generally.

The first part of this bulletin deals with the fundamental causes of soil erosion and then discusses the need for *regional planning* in agriculture. A most useful table, from which the type of farming to which an area, or even an individual farm is potentially best suited, has been drawn up. This table should be extremely useful to members of committees of Soil Conservation Districts who are responsible for the planning of farms, as well as to others interested in the correct use of land, and is of general application.

The second part of the bulletin deals with the main agro-ecological regions of Natal. The writer divides Natal into eight main regions of which he describes the vegetation, soils, topography and rainfall and then, on the basis of the table mentioned above, shows the types of farming to which each region is potentially best suited. An excellent map of Natal accompanies this description.

The writer further indicates how this system of agro-ecological survey could be applied to the whole Union, and presents another excellent map, which, from his observations in the past might serve as a basis for such a survey of the whole country.

Copies of this bulletin are obtainable from the Editor, Department of Agriculture, Pretoria. Price 3d. prepaid.

Control of Eelworm.

(With Special Reference to D-D.)

Dr. W. J. van der Linde, A. J. Smith and Dr. L. J. Neethling,
Division of Entomology.

EELWORM, a small round worm or nematode, is responsible for a condition known as "root-knot" in susceptible plants of which more than 1,300 are already known. The other name "vrotpootjie" is undesirable, since other plant diseases are already known under this name and this will cause confusion.

Although root-knot has virtually spread throughout all the inhabited parts of the globe, it is principally a pest which is of economic significance in the warmer regions. As far as it is known it is indigenous to Southern Africa.

Enormous damage amounting to hundreds of thousands of pounds is caused annually by this worm. The full extent of the damage is not always fully appreciated, since not only the yield, but also the quality and market value of the crop is most adversely affected. For potato, vegetable and tobacco farmers it undoubtedly ranks as one of the most serious pests.

Characteristics of Root-Knot.

As its name indicates, knots usually develop on the roots of infested plants. If well-advanced roots become infested, the knots are usually small and generally appear on the lateral roots. If, however, roots are attacked at an early stage, the knots grow to an enormous size and a high percentage of such plants usually dies. Where the main roots of plants are severely infested, the plants are stunted in growth and yellow and such plants soon wilt in dry hot weather.

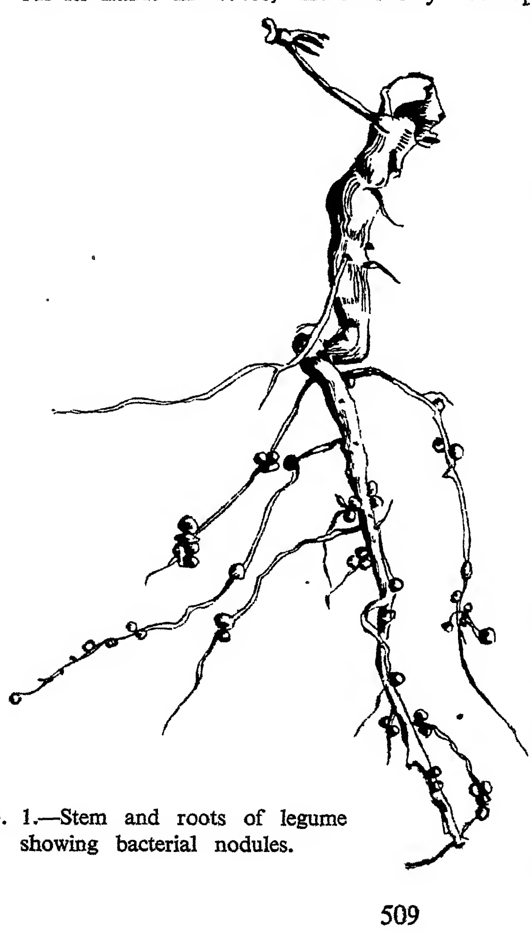

FIG. 1.—Stem and roots of legume showing bacterial nodules.

The size of the knots is largely determined by the plant variety. Very large knots may be formed on the roots of tobacco, tomatoes, pumpkins, beans, stinkblaar (*Datura stramonium*) etc., while those on mealies, strawberries, freezias, irises etc. are small.

Again, on potatoes the knots are pustulous.

The symptoms on the upper parts of infested plants vary greatly. Plants such as tobacco, beans, beet, etc., which are highly sensitive to infestation, either die or are stunted. They wilt more readily and become yellow, whereas pawpaw, figs, peaches, zinnia etc., can tolerate a heavy infestation, and show few, if any, symptoms in the aerial parts, although their growth may still be retarded. Other plants again, such as sunn hemp, velvet beans, cereal and grass varieties, are highly resistant to eelworm infestation.

FIG. 2.—Tobacco root severely infested with eelworm.

Apart from the direct damage, the root-knot eelworm may also cause indirect losses by rendering plants more susceptible to bacterial and fungous diseases, e.g. wilt diseases in cotton and rhizoctonia in groundnuts.

Furthermore, plants infested with eelworm are not very resistant to droughts.

Nodules of Nitrogen Bacteria.

Legumes carry on the surface of their roots nodules of beneficial nitrogen bacteria, and these nodules should not be confused with eelworm knots. They are distinguishable from each other by the fact that the

eelworm nodules are formed within the tissue of the root and cannot be removed without injury to the root. (c.f. Fig. 1 and 2).

It sometimes happens that the bacterial nodules also become infested, and certain cases have been observed where the infestation was confined to the nodules.

Life-Cycle and Habits.

Eggs, larvae, mature as well as immature eelworm females may be found in the tissue of the knots. The eggs and larvae are minute (Fig. 3) and cannot be seen with the naked eye. The full-grown female is pear-shaped, pure white and appears as a little white speck about one-quarter the size of an ordinary pinhead. (Fig. 4.)

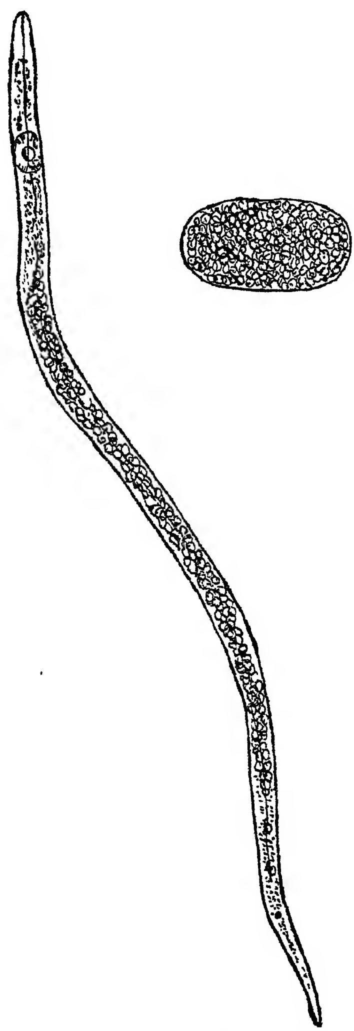

FIG. 3.—Larva and Egg of Eelworm. Highly Magnified (Semi Schematic).

The males are worm-like and considerably larger than the larvae—they are very rare and are found only when conditions are unfavourable for the development of eelworm as, for example, in old and heavily infested roots.

One female produces up to 1,000 eggs. The eggs are enveloped in a gelatinous sac which hardens and serves as a protection against drying out. The eggs are usually found in the knot where they develop; if a female happens to be near the surface of a root, the egg-sac may be forced out into the soil.

As a rule the eggs develop without being fertilised. The young worms or larvae which hatch in the knots, may remain there or may emerge and move through the soil to uninfested parts of the same roots or to roots of other plants. When conditions in the soil are unfavourable, the larvae remain very inactive. They usually enter roots at the growing tips, but may also enter at other points; once in the root, the larvae slowly grow to maturity. The presence of the worm in the plant tissues causes the formation of giant cells, giving rise to the knots which are externally visible on the roots. Furthermore, twisted vascular bundles result, which interfere with the feeding of the plant. Such infested plants are stunted and are less resistant to diseases and unfavourable conditions, such as, droughts, poor soils, etc.

Free larvae are able to survive for a long time in the soil, ready to cause infestation as soon as susceptible plants are grown.

According to Tyler and others, 27° C. is the most favourable temperature for the development of the root-knot nematode. Development is retarded if the temperature rises or falls, thus: at 27° C. it takes only 25 days for the completion of the life-cycle of the organism, while at 16·5° C., it extends to 87 days. No eggs are laid at temperatures above 31·5° C. or below 14·3° C. Larvae enter roots at a temperature as low as 12° C. and as high as 35° C., and it takes from 21 hours to 35 days for knots to form at a temperature of 35° C., while at 14° C. it takes 9 to 11 days.

The duration of the life-cycle is also strongly influenced by the host plant. According to Godfrey the time required for the completion of the life-cycle from the larva to the egg-laying stage is 35 days in pine-apples and 19 days in cowpeas, under precisely the same conditions.

In the Brits area, according to temperatures taken 10 inches below the surface of the soil, 8 to 10 generations can be completed annually, provided host plants are always available. Naturally, in practice, there is always a period when no favourable host plants are present on the lands, e.g. during the wheat season, if no susceptible weeds are growing amongst the wheat plants.

Prevention.

"Prevention is better than Cure", should be the motto of every agriculturist, since it is the easiest and, at the same time, the least expensive method of preventing damage by the eelworm. This may be achieved by—

(1) planting uninfected seedlings, tubers or bulbs only;
(2) removing and destroying infested roots or portions of plants early from the lands;
(3) examining regularly the roots or underground parts of plants, to determine the degree of eelworm infestation on the lands, in order that rotational cropping may be applied with resistant crops, etc.;
(4) introducing drainage furrows which will prevent water flowing from eelworm-infected ground on to clean lands.

Control.

Where ground is infested, measures should be taken to combat the eelworm. This is particularly necessary in the case of seed-beds, since the quality and size of the crop are largely determined by the healthy condition of the plants. Plants free from eelworm yield far better crops even if transplanted on infested land. Infested plants, apart from the fact that they produce inferior crops, infest the lands as well. Money spent on the control of eelworm, must, therefore, be regarded as an excellent investment.

Eelworm can be controlled (*a*) by treating the soil with chemicals and/or (*b*) by applying sound agricultural methods of cultivation.

(b). Chemicals.

In the past various chemicals have been applied for the control of eelworm. These chemicals either did not give satisfactory results or were far too expensive. Recently, however, a new soil fumigant, "D—D", has come on the market and has given excellent results.

D-D is the trade name of a liquid, the chief constituents of which are 1:3 dichloropropane and 1:3 dichloropropene. It is a new product and is manufactured by an Oil Company.

It is dark brown in colour, being virtually a black liquid, relatively volatile and poisonous to both animals and plants. Persons working with the fumigant should take care not to inhale the fumes, and not to allow the liquid to come into contact with the skin or even clothes and shoes, since it causes serious skin irritation. If the liquid does get on the skin,

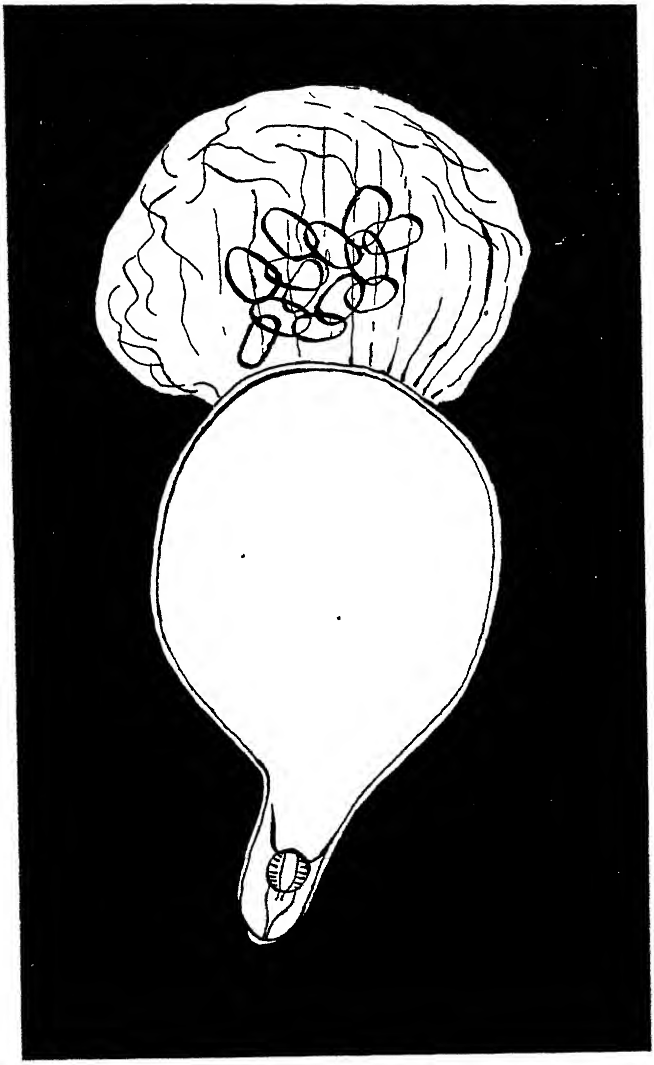

FIG. 4.—Adult female with egg-sac—diagrammatic.

it should be washed off immediately with paraffin or soap and water. Under no circumstances should D-D be sucked from cans or retainers, as this may have fatal results.

Treatment of Small Plots Such as Seed-Beds.

Thoroughly prepare the ground. All clods must be pulverised and undecayed plant roots removed where they appear in the soil. If the addition of compost is necessary, it should be worked in early, before

treatment. In the case of clay types of soil, the ground should be damp, and in the case of sandy types, the soil should be wet at the time of treatment.

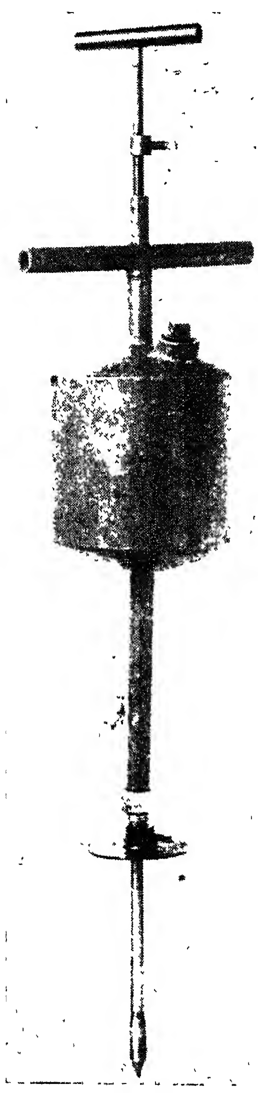

FIG. 5.—Soil Injector. 1—Plunger handle; 2—Set screw to regulate dosage; 3- Handle; 4—Plug; 5—Container; 6—Cylinder with plunger; 7—Baseplate to regulate depth; 8—Apertures in point of injector.

Before the fumigation is carried out, the soil injector (Fig. 5) must be adjusted to supply the required quantity of D-D. For seed-beds 6 c.c. (about 1 teaspoonful) per sq. foot is recommended, which is approximately 1 pint per bed measuring 3 ft. × 30 ft. A dosage of more than 6 c.c. per hole will not be injurious, but it is not advisable to inject less. The distribution of the points of introduction in a bed 3 ft. wide is as follows: two rows are 6 inches away from the sides of the bed and one row in the middle of the bed. Points of introduction are all one foot apart. For a standard bed of 3 ft. × 30 ft., there will be 90 points of application.

D-D must be injected at a depth of 8 inches. Immediately after application each hole must at once be closed and the soil sealed with water in order to prevent the D-D fumes from escaping. This is done by watering the bed with a garden-hose or watering-can to a depth of approximately 3 inches immediately after the application.

The water used on the seed-beds should be drawn from a well or bore-hole, since river and dam water may possibly be infested with eelworm.

If a soil injector is not available, D-D may be applied by means of a funnel. In such a case a teaspoonful must be poured into each hole and care should be taken to pour it at the required depth of 8 inches. After the treatment the soil should be sealed as indicated above.

Since D-D fumes are injurious to plant life, plants or seed should not be planted or sown in the treated ground before a period of ten days has elapsed.

(b). Cultural Methods.

Where tobacco is cultivated under dry-land conditions, a land or portion of it may be treated with D-D. The soil should be thoroughly damp or wet. Then 6 c.c. of D-D is injected with the soil injector (or

teaspoon and funnel) into the holes where the plants are to be planted and each hole immediately closed down.

If dry conditions prevail, every treated hole must be sealed with water immediately after treatment.

By means of a special appliance which can be attached to a plough, lands can be treated with D-D. (Figs. 6 and 7). The appliance has been so designed that a constant quantity of D-D, previously determined, is poured into the furrows and immediately closed with the shear behind. To ensure uniform speed and even distribution, the plough must be tractor-drawn.

Although succesful results have already been obtained with this appliance on badly infested lands, it is not yet recommended for general use. Farmers who are interested, should contact the Chief, Division of Entomology for further particulars.

FIG. 6.—Treatment of land with D-D. The large 45 gallon drum on the plough feeds the three smaller containers, each automatically closed ; each container allows a certain fixed quantity of liquid into the corresponding furrow. The roller at the back of the plough presses the loose soil down to prevent the D-D fumes from escaping.

Control of eelworm by means of cultural methods may be briefly summarized as follows:—

(a) *Desiccation.*—Eelworm cannot survive in dry soil. Thus, by allowing the ground to dry thoroughly by frequent ploughing during summer, the infestation may be considerably reduced.

Although reasonably good results may be obtained by this method, control is disappointing since the soil never dries out uniformly. This enables the worms to travel from dry to damper parts in their immediate vicinity.

Apart from the disadvantages mentioned, the method is not only relatively expensive, but it also exposes the soil to wind and water erosion and cannot, therefore, be recommended.

(b) *Fallowing.*—By allowing lands to lie fallow and removing all weeds regularly, the infestation can be greatly reduced.

Quite apart from value in eelworm control, the fallowing of land is a sound practice from an agronomical point of view. The period for which a land should lie fallow will largely depend upon the degree of infestation.

(c) *Rotation of Crops.*—By rotating less or non-susceptible crops with susceptible plants, eelworm may to a very large extent be controlled on lands. The duration of the system will be determined by the normal susceptible cash crop, which is to be cultivated after the rotation series. In the case of heavily infested lands it is necessary to grow resistant crops for three, or even four summers before again planting a susceptible crop. For cultivaiton of susceptible plants, such as tobacco, sunflower and tomato, etc., good results can be obtained by this method. It is, however, less succesful in the cultivation of seed potatoes. On infested land the following rotation series may, for example, be applied: *In winter*—wheat, rye or oats, or fallowing with clean cultivation. *In summer*—summer crops, sunn hemp or ground-nuts. Not all summer cereals are entirely resistant to eelworm, e.g. although the growth and yield of maize and kaffircorn are not adversely affected, there is nevertheless a small degree of infestation and propagation.

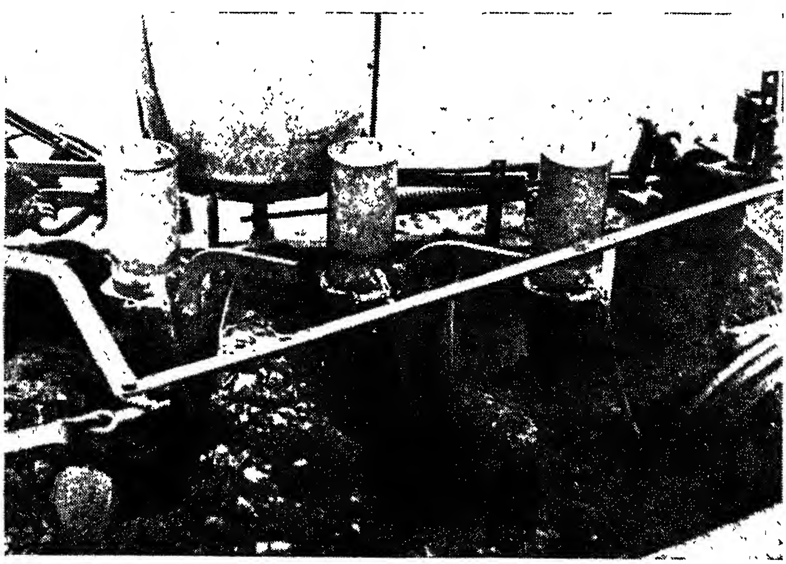

FIG. 7.—Three furrow plough with three small containers with conducting pipes and tap by means of which the required amount of D-D can be regulated.

On infested land good crops may be expected from susceptible plants, such as, cabbage, lettuce, peas, etc., during the winter months, since the eelworm is then far less active than during the summer months.

Summary.

The use of D-D in eelworm control in seed-beds is recommended for the following reasons:—

(1) If healthy seedlings are transplanted, clean lands cannot become infested.

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Codling Moth in Pome Fruits.

Dr. Bernard Smit, Principal Entomologist, Pretoria.

FOR many years Colding Moth has been considered to be the worst insect pest of pome fruits, such as apples, pears and quinces, in South Africa, as it has also been in other apple-growing countries throughout the world. It was particularly serious in the western Cape Province, where most of the apples and pears in South Africa are grown. For this reason most of the work on Codling Moth in South Africa has been done at Stellenbosch, Elsenburg and Bien Donne, and the names of entomologists like Dr. F. W. Pettey, Dr. C. W. Mally and more recently Dr. R. I. Nel and Dr. W. Stubbings have become well known on account of their basic research work on this problem.

Spraying has always been the method of control mainly relied on, but various supplementary methods such as banding trees, trapping the caterpillars in packing sheds and removing of infested fruits have also been advocated. The importance of the disposal of all infested fruits in such a way that the caterpillars in them cannot escape and develop into moths, which in turn may fly out into the orchard to carry on the infestation, has always been strongly stressed.

In regard to the spraying, the first insecticide used was arsenate of lead, and a great deal of work was done to ascertain just when the spraying should be carried out. Farmers were advised to use bait traps in the orchards to indicate when the moths were most abundant and when the Codling Moth eggs were being laid.

The correct strength of arsenate of lead was carefully worked out and better methods of applying it were devised. Then, later it was mixed with a spreader to make it spread and stick better on to the fruit and leaves. Spray oils with nicotine were also advocated to destroy Codling Moth eggs on the fruit and leaves and so reduce infestation.

Whilst excellent results were obtained at first, the control of the pest became very disappointing in many orchards after a while. Even where spraying was carried out very thoroughly and as many as twenty applications were put on, complete success was often not attained.

Moreover, the spray-residue problem became more and more acute, and in order to remove the arsenic from the fruit it was necessary to wash it carefully in solutions of hydrochloric acid. The acid had to be kept at just the correct strength and temperature, and this again proved to be difficult and troublesome.

Then came fixed nicotine, which is an ingenious combination of nicotine and bentonite clay. This formed a stable insecticide which was used as a stomach poison and as a substitute for arsenate of lead in the sprays applied later in the season; thus avoiding the arsenic-residue difficulty.

The great objection to fixed nicotine was its prohibitive cost, and at one time it was almost unprocurable. Farmers reverted to the use of cryolite, but this too was not very satisfactory, and it was not until the advent of D.D.T. that the possibility of really controlling the Codling Moth appeared. At first the entomologists were very hesitant about recommending the use of D.D.T. in orchards because of the danger of killing beneficial parasites of the Codling Moth and other pest insects. Some of their fears have been realised, but the effect of D.D.T. on Codling Moth, both in the caterpillar and the moth stage seems to be so complete that there is a general inclination to apply the D.D.T. in spite of the dangers. In a recent letter, Dr. Stubbings of Stellenbosch says that he searched for Codling Moth in a large commercial pear orchard

for an hour in early January without finding a single infested fruit. This was after the orchard had been sprayed with D.D.T. according to his instructions. It is apparently the residual effect of the D.D.T. and its good sticking properties in addition to its toxicity that make it so effective.

Comparatively little research work has been done on the control of Codling Moth in South Africa, apart from that done in the fruit areas of the western Cape Province.

Petty carried out some experiments at Kempton Park near Johannesburg years ago, and Hepburn and Bishop have done some work in the Langkloof. More recently Ullyett and Van der Merwe have done some experiments on biological control of Codling Moth at Pienaarspoort near Pretoria. The general impression is that Codling Moth can be controlled with fewer sprayings in the Langkloof and in the summer rainfall areas than in the western Cape Province. Where, in the western Cape Province, from 16 to 20 sprayings with arsenate of lead were necessary, only from 5 to 6 were needed in many other parts of the country. In some parts, as at Haenertzburg in the Transvaal, the Codling Moth has hardly become a pest at all and practically no spraying has been necessary.

Control in the Summer Rainfall Areas.

In view of the lack of scientific data on the control of Codling Moth in the summer rainfall areas of South Africa it is difficult to give specific recommendations, but seeing that there is a great demand for information on the control of this pest in these "Highveld orchards", it is necessary to give some advice, and farmers who need to control the pest can, to advantage, try a modified present-day western Cape Province programme.

D.D.T. sprays have not yet been tested in the Highveld, but judging from the results that have been obtained in the western Cape Province, the author feels that they should be given a trial. Such new methods should, however, first be tested in a section of an orchard before spraying the whole orchard with the new insecticide. In order to avoid, as far as possible, killing beneficial parasites, both of the Codling Moth and other pest insects such as Woolly Aphids, the D.D.T. should be applied as sparingly as possible. Fortunately, fixed nicotine is again available and can be used at the end of the season to avoid the spray-residue problem.

The following spray programme is therefore suggested tentatively, but it will of course have to be modified according to weather conditions and the consequent development of the fruit in the orchard. It will probably also have to be changed as more information is gathered on the general question of Codling Moth control in the areas outside the western Cape Province.

Where the Leaf Spot Disease, Fusicladium, is troublesome, two sprayings with lime sulphur should be applied in the programme before the D.D.T. sprays.

The form of D.D.T. now most commonly used is a wettable powder, and this can be obtained in various grades or strengths.

The actual strength of pure D.D.T. required to kill the insect is one pound in each 100 gallons of spray.

As the wettable powder is made in various strengths of 25, 33⅓ and 50 per cent., the amounts of powder to use are as follows:—

25 per cent. powder	4 lb. per 100 gallons.
33⅓ per cent. powder	3 lb. per 100 gallons.
50 per cent. powder	2 lb. per 100 gallons.

 [Continued on page 552

Conservation Problems of the Karoo.

Dr. C. E. Tidmarsh, Grootfontein College of Agriculture,
Middelburg, C.P.

Retrogressive Processes and Desert Movements.

THE Karoo and adjacent grassveld areas have been the scene of vast changes and deterioration during the past century. Although these retrogressive trends have been most marked and acute in this part of the country, they are symptomatic of a general widespread process of decay operative in South Africa as a whole, and are distinguishable from similar trends in other regions only in degree.

Figures 1 and 2 indicate the extent to which the Karoo has encroached on the adjoining grassveld areas during the past hundred years, or, more correctly, the extent to which the grassveld has retreated and been replaced

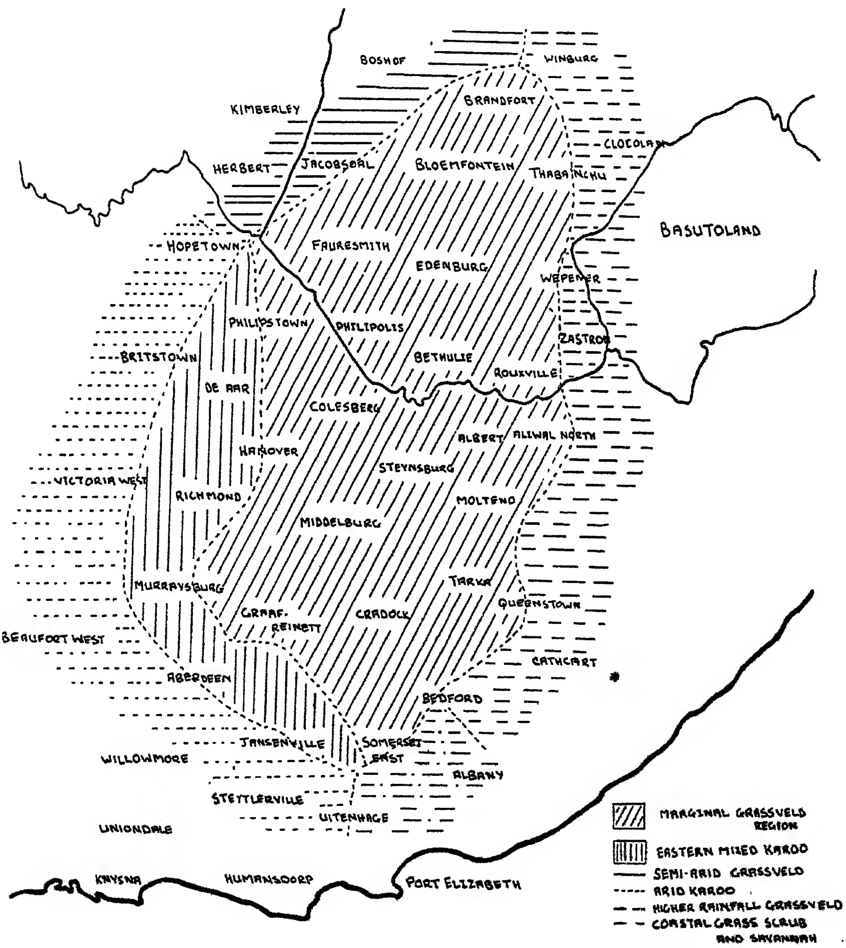


FIG. 1.—Sketch map of portion of the Union of South Africa showing distribution of vegetation types approximately 100 years ago.

by Karoo vegetation. These maps have been prepared from reconnaissance survey, and from accumulated documentary evidence, including descriptions of these areas at earlier periods, as well as statements of old inhabitants relative to conditions fifty years, or more, ago.

Brown (1875) has quoted a letter written in 1864 by J. H. Davis, of Colesberg, in which "the gentle undulating country, extending from the Sneeuberg mountains to the Orange River, reckoned by many amongst the prime sheep walks of the Colony", is described as follows:—

> "The most luxuriant grassy parts of the sweet veld are generally plains nearly horizontal, which, not having a quick water-shed, retain much moisture; and the light, sandy soil, lying frequently but a few inches thick upon the hard Karroo soil below, is preserved from being washed away . . . for it may be observed almost everywhere, that where these plains are inclined, even at a low angle, the light top soil does get washed away, leaving the hard earth below exposed at the surface, and wherever this takes place the grass disappears, and the heaths, with other short scrubby plants, spring up. This change appears to me to be rapidly taking place in this part of the Colony, and it is promoted, perhaps often induced by the feet of the sheep; they make little paths in every direction, and the water flows in these paths as so many little channels, washing away all the light earth, and the grass roots get exposed and gradually disappear. Many farms which I remember 15 or 16 years ago to have been rich in grass are now almost bare of it, even in the most favourable seasons; and this process is, I believe, gradually but surely passing over the whole country wherever sheep are introduced".

Barrow (1801) travelled this same country in 1797 in a severe drought and described it, nevertheless, as good pasturage "swarming with game" and "destitute of every appearance of bush or shrub . . . The Sea-Cow River, and indeed all the streams that behind the Snowy mountains ran northerly, were remarkably distinguished from those whose currents took an opposite direction, by having their banks covered with tall reeds, the arundo phragmites, and destitute of shrub or tree . . . The northern rivers consisted generally of a chain of deep stagnant pools connected by the beds of narrow channels". He was also struck by the great absence of stones in these vast plains . . . a significant observation, in view of the prevalence of stones to-day. The condition of the Sneeuberg mountains which are at present largely occupied by Mixed Karoo vegetation and taller shrubs (*Elytropappus, Euryops,* tall *Lyciums* and others), is clearly depicted by this passage; "But that which discriminated the Sneeuberg from other parts of the country, was the total want of shrubbery. For miles together these elevated plains produced not a stick". The Sneeuberg was described as well grassed and excellent pasturage, with cattle dung the only source of fuel for the inhabitants.

It is of interest, also, that the country around what is to-day Middelburg, Cape, was described by Barrow as "fine grass" plains, extending eastwards to the Bamboesberg; and it was only on his descent into the hot, dry valley of the Fish River that elements of the Karoo flora are again mentioned in any quantity.

Shaw (1875) reports in the same strain as Davis, quoted above. He states that, "When first introduced, they (merino sheep) fed mainly on grass; and in a country with its periodical or season-rains, and under a high sun, the (grass) family soon began to give way and succumb. Suffruticose plants, and in general shrubs, could alone stand against the sheep and such a climate; and at first, and as long as the grass was prominent, these

would enjoy immunity from the sheep. But the grass vanished very rapidly, and the bush and shrubs came to be the main resource of flocks . . . The climate necessarily became affected. The rainfall came down less certainly, and oftener in the form of thunder torrents. Side by side with the attacks of the flocks, the more subtile and insidious agency of a changing climate came into power. The hardy plants of the Karoo commenced to travel northwards, and added their energies to the extirpating of the indigenous and proper flora of the region; . . . and (the veld) is rapidly becoming an extension of dreary, scrubby, half desert Karoo ".

A valuable contribution has also been made recently in this connection by De Klerk (1947), whose accumulation of documentary evidence points in the same direction.

Easterly Encroachment of the Karoo.

From the foregoing it is apparent, as indicated in Figures 1 and 2, that although there has been movement northwards, the main advance of the Karoo has been in an easterly direction, and that the grassveld has retreated, from west to east, a distance of approximately 150 miles

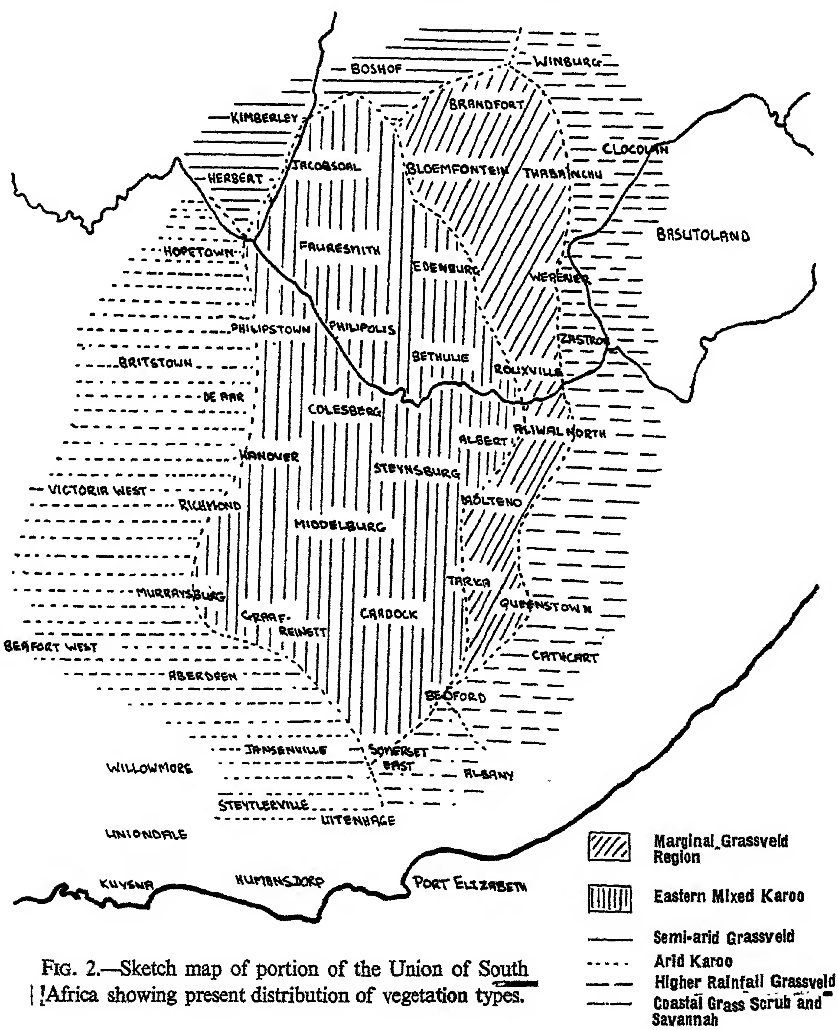


Fig. 2.—Sketch map of portion of the Union of South Africa showing present distribution of vegetation types.

during the past century, representing an average speed of 1½ miles per annum.

The replacement of grassveld by Karoo vegetation has been attended by dire consequences, of which the starting point is a great reduction in the vegetal cover of the soil. The magnitude of this will be appreciated when it is realized that the average cover of the Mixed Karoo is at present barely 25 per cent., and that of the Arid Karoo, to the west, considerably less. This is an estimate based on actual measurements in relatively small areas, in which figures for basal cover as low as 5 per cent. are common. On the other hand, under grass, where such still survives, close stands, in average situations, are occasionally observed. In all events, there can be no doubt that the soil cover afforded by the erstwhile grassveld was vastly greater than that of the Karoo vegetation at present, and the realization that upwards of 75 per cent. of the surface of the Mixed Karoo consist to-day of bare soil, stones and shales, is truly alarming.

This baring of the soil surface set in motion that most vicious train of reactions—desiccation, erosion and depletion—to which so much prominence is given in all writings and discussions on the subject of soil erosion. The proportions to which soil losses have attained in the Karoo areas, by sheet erosion, is most disquieting. The rate at which surface soil is at present being lost, by wind and water, is estimated, from direct measurement against plants at Middelburg, Cape, to be approximately half an inch per annum. In one instance, losses of as much as 1½ inches were recorded in one year. Although it is conceded that these figures probably do not reflect the actual net loss of soil from the whole area in which the measurements were made, they are nevertheless sufficiently indicative of the activity of soil movement. In certain relatively level areas, which have been under observation at the Grootfontein College of Agriculture, sandstones and shales, which were, 8 years ago, covered by several inches of soil, now lie exposed at the surface. Numerous other instances of this nature can be cited, and it is quite evident to any competent observer that, throughout vast tracts of the Mixed Karoo at present, all that remains of the former covering are stiff, shallow sub-soils.

Indications of a Fifth Desert Invasion.

Although quantitative evidence is not available for the Arid Karoo and desert regions to the west, it is generally agreed by the older inhabitants, and by those who are well acquainted with these regions, that depletion on a similar scale has been enacted in them. Indications are still clearly evident of these areas having formerly supported a more luxuriant growth of the desert grass species, notably varieties of the renowned "Boesmangras" (*Aristida obtusa* and others). From Figures 1 and 2 it will be seen that the area formerly represented as Eastern Mixed Karoo, and which may well have extended further west, is at present indistinguishable from Arid Karoo. Thus a general shift from west to east of desert conditions across the face of South Africa is depicted, in which each successive region is progressively losing ground to its more arid neighbour in the west.

Independent, corroborative evidence has recently been supplied by Bosazza, Adie and Brenner (1946), in a preliminary report entitled "Man and the Great Kalahari Desert" from which Figure 3 has been reproduced. This map, based on geomorphological evidence, indicates clearly the movements of the deserts in southern Africa. These authors describe the magnitude of soil losses, particularly by wind, in the Karoo areas, and their net movement eastwards. This factor, with its attendant evils of desiccation and depletion, is considered the main criterion in desert

movement, and the soils of the Mixed Karoo are described as truncated subsoils, over vast areas eroded to the C horizon. The annual soil loss is estimated at approximately half an inch.

It is apparently agreed by geographers and geologists that southern Africa has previously, in recent geological history, been invaded on at least four separate occasions by deserts, which extended from coast to coast, and that man and beast either perished from famine in the invasion, or retreated before it. It transpires, further, that the country is now experiencing its fifth desert invasion, and that our animal and human populations are once more threatened with ultimate extermination or evacuation.

Causes.

Whatever the causes may have been of the previous invasions, for which various suggestions have been advanced, we are more particularly, and immediately concerned with this, the fifth invasion of the desert.

Much has been said and written in recent times concerning the retrogression and depletion evidenced on almost every hand in the country to-day, and after each succeeding major drought, with its heavy toll of stock and crop losses, a wave of speculation has arisen. The first systematic attempt to investigate and weigh the possible causes of the observed phenomena was undertaken by the special Drought Investigation

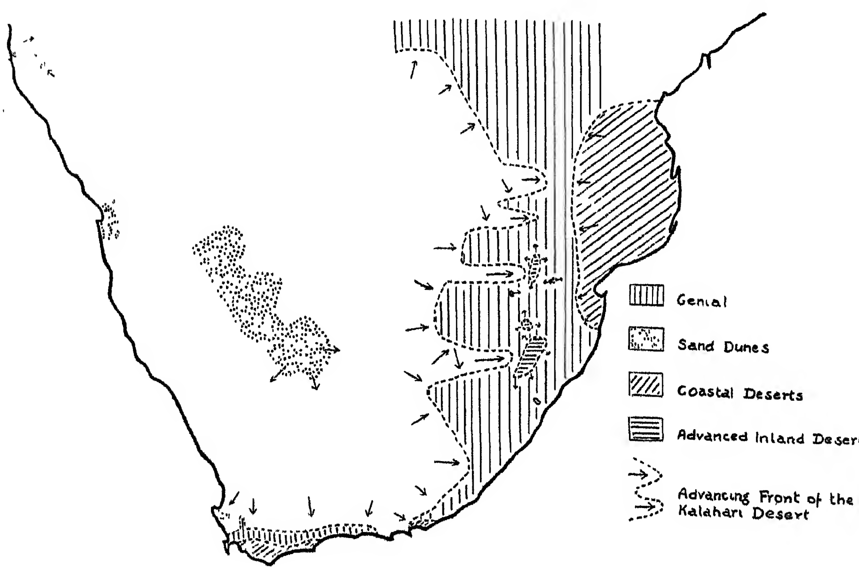


FIG. 3.—Sketch map of South Africa showing the Kalahari Invasion. (After Bosazza, Adie and Brenner, 1946.)

Commission, whose momentous report, published in 1923, has been largely responsible for framing the opinions, and supplying the tenets and views to which we still cling. Its findings and conclusions have been generally accepted without question, and its recommendations have been instrumental in formulating the agricultural policies of our day. In this report, as in more recent writings, and in our present prolific propaganda, the main emphasis is laid on incompatible and abusive farming practices, such as overstocking, herding, burning, etc., and a comprehensive account of the deleterious effects of these is given at length. These factors are

stressed to the exclusion of all else, and that there is any evidence of diminished rainfall is categorically denied, and is consistently quoted to this day.

Diminished Rainfall.

While the value and importance of the work, findings, and recommendations of the Drought Investigation Commission is fully conceded, it appears that in its conclusions regarding climatic change, it was definitely at fault. Schumann and Thompson (1934) have subsequently established that since about the year 1890, the Cape Midlands have experienced a distinct diminution of rainfall, that this decrease has become accentuated since 1917, and that practically the whole of South Africa has experienced a diminishing rainfall since that year. It is indeed remarkable that so important and radical a disclosure should have been accorded such scant recognition and publicity, particularly as it supplies the key to the understanding of so much that has been obscure and contentious in our country. It may be that those most closely concerned have found consolation in the authors' statement that there is no proof, however, of any permanent diminution, and that there is reason to believe that during some future epoch the present downward trend may be followed by an upward one. However that may be, this publication is of such moment that it merits quotation at length of some of its most significant passages here. These are as follows:—

> " The writings of various other observers and investigators also substantiate the fact that vegetational changes have been observed over an extended period. Evidently a great diversity of opinion existed concerning the causes thereof, and this diversity of opinion persists to the present day. There can be no doubt that veld burning, overstocking, unsympathetic grazing, low soil fertility and other factors, singly and collectively, contribute to bring about the undesirable conditions.
>
> A study of the rainfall figures of the past 40 to 50 years suggests strongly that the influence of this factor on the vegetation over the greater part of the country has been far-reaching. As previously pointed out, in the Midlands a general decrease in rainfall is indicated since approximately 1890. This decrease has become accentuated since 1917, practically the whole of South Africa having experienced a diminishing rainfall since that year. At the same time an increase in the animal population is shown. Merino sheep increased from twelve to twenty-eight million during the period 1904 to 1913; from 1913 to 1925 the number was more or less constant at twenty-five to thirty million, and from then on increased to forty-five million in 1932. Cattle increased from three and a half million in 1904 to ten and a half million in 1930. Palbably then these two factors, viz a decreased rainfall coupled with an increase in stock, are inseparable in explaining the reduced value of the vegetation in latter years. "
>
> " Although such factors as overstocking, faulty veld management, etc., are rightly stressed by the Drought Investigation Commission as partly responsible for drought losses, insufficient attention seems to have been paid to actual long period variations in the rainfall. The depopulation of the Midlands since 1891 seems to be closely correlated with factors pertaining to a diminished rainfall over a number of years."
>
> " It is interesting to note that practically the whole of Natal, Transvaal and part of the Orange Free State were subject to this diminishing rainfall since approximately 1917."

"The importance of all the factors (veld burning, etc.) enumerated in modifying vegetation and other dependant aspects is fully appreciated. The rainfall of the country, however, in the light of this investigation, casts new light on the subject. If it be considered that since the peak rainfall period of 1890 there has been a decrease approximately of 130 per cent. to 80 per cent. (with minor peaks) in the total rainfall over a large part of the Union, the effect on the vegetation can well be visualised. It is suggested, therefore, that the low level of the rainfall over large areas during the period under discussion accounts to a great extent for the dwindling of the flora, accentuated by such factors as overstocking, veld burning and various other causes."

Any suggestion that the observed diminution in the rainfall may form part of a cycle is discounted by the following passage:—

"The absence of definite cycles in South Africa is emphasized here, since many people attach great importance to supposed cycles, in spite of the fact that they have for the most part proved to be an illusion, or at least, of minor importance as compared with non-periodic fluctuations."

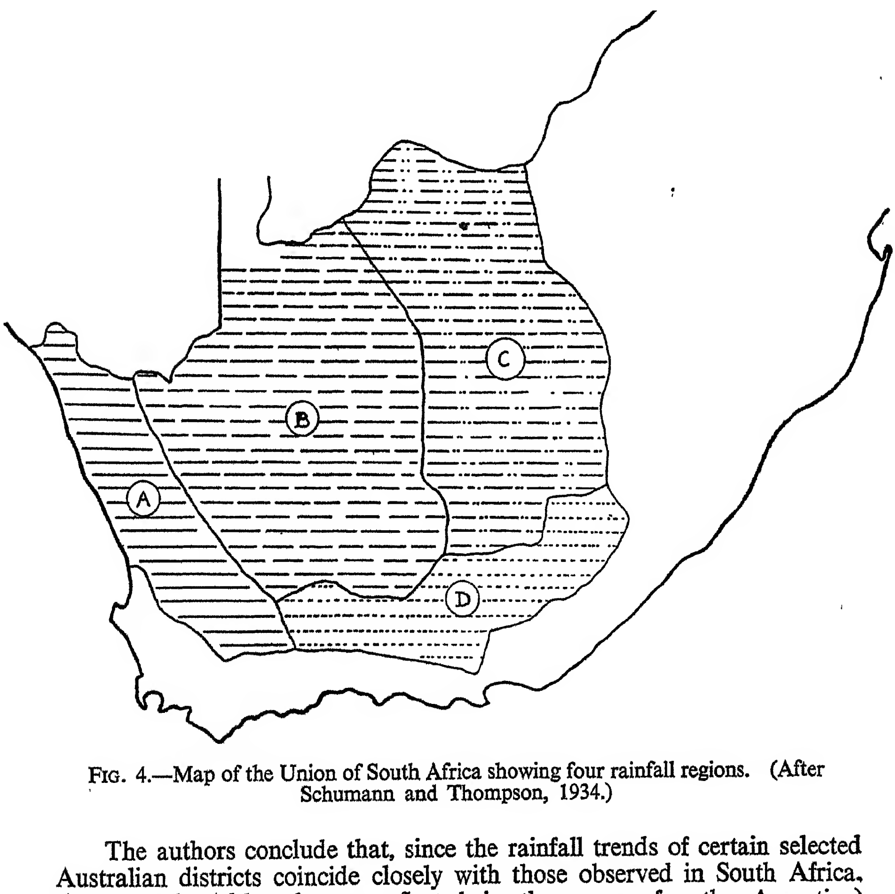


Fig. 4.—Map of the Union of South Africa showing four rainfall regions. (After Schumann and Thompson, 1934.)

The authors conclude that, since the rainfall trends of certain selected Australian districts coincide closely with those observed in South Africa, these trends (although not reflected in the curves for the Argentine) represent widespread secular variations of the southern hemisphere, possibly due to southerly shifts of the high pressure belt of the horse latitudes, and that any attempt at control by human agency must necessarily prove

futile. This conclusion may, or may not, be wholly correct, and is discussed later in this article. (The authors themselves state that very little direct evidence can be adduced in support of this "theory", but that experience gained in the Union meteorlogical office during the past years makes the supposition very likely.)

Problems and Hypotheses.

From what has been said so far, it will be evident that the processes of retrogression and depletion, evidenced in such acute form in the Karoo and adjacent areas, have resulted from a variety of causes, embraced in incompatible farming practices, in combination with climatic deterioration. Either of these alone would, no doubt, have been capable of producing, in time, similar effects, but in combination the result has been disastrous.

The problems thus confronting us, are—

(1) whether on these shallow, intractable sub-soils, under deteriorated climatic conditions, it is possible, by any means at our disposal, to restore the vegetation to a level at which the soil will become stabilized, and regenesis promoted;

(2) whether the observed diminution in rainfall is in truth wholly a temporary and widespread secular process, entirely beyond the influence of man, or whether it may be partially an induced effect, and if so, what measures can be applied to alleviate the condition.

In respect of the first, the results of about twelve years research, conducted principally at the Grootfontein College of Agriculture, are not very encouraging. A comprehensive series of treatments, methods, and

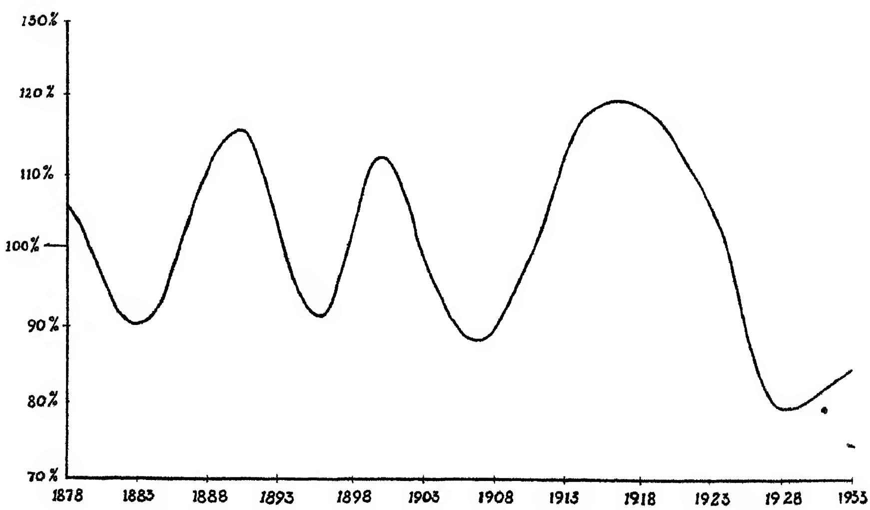


FIG. 5.—(*Graph A.*) Smoothed rainfall graph of Region A (Figure 4). (After Schumann and Thompson, 1934.)

systems of grazing management and control, including complete protection from livestock, have been applied over a range of different soil and veld types. Recently, also, in the Vlekpoort Conservation Area, and elsewhere, attempts at revegetation by various cultural methods and reseeding have been undertaken, both alone, and in conjuctiton with mechanical soil conservation works, under strict grazing control, and complete protection.

The results of all these endeavours, like those of the anti-soil-erosion campaign during the past fourteen years in these areas, have (with the exception of local effects of large structures) as yet been largely negative, and although all the possibilities have not yet been fully explored, the results that may be expected from this line of attack do not, at present, appear very hopeful, and if all the conclusions of Schumann and Thompson are strictly correct, until such time as the rainfall trends should make an upward swing, the outlook would indeed seem rather gloomy.

Desiccating Power of the Western Wind.

With regard to the problem of climatic deterioration, a hypothesis has recently been put forward, in which it was suggested that the advances of desert conditions, from west to east, across the face of South Africa, may in a large measure be attributable to an increased desiccating power of the western wind. In a country like South Africa, in which, over by far the greater part, the limiting factor to vegetation is indisputably moisture supply, and in which evaporation (including transpiration) is undoubtedly the greatest source of loss, in which the western winds are the greatest culprits, it is submitted that anything which tends to increase the evaporative power of these winds, must inevitably have vast and far

FIG. 6.—*(Graph B.)* Smoothed rainfall graph of Region B (Figure 4). (After Schumann and Thompson, 1934.)

reaching effects on the vegetation. In this connection it was suggested that destruction of the vegetal cover of the western deserts and Arid Karoo, by increasing soil temperatures, by the greater exposure of bare earth surfaces to direct insolation, thus accentuating horizontal temperature gradients, and by aggravation of dust storms, may well have caused increases in the temperatures and velocities of the western winds, and that their desiccating powers had become thus greatly enhanced. To these may be added, also, the possible factors of increased frequency, and reduction in actual humidity of these winds, by denudation of the western regions over which they pass. It is indeed a common belief of those living in closest contact with Nature, that the western winds have, in latter years, increased in both velocity and frequency; that whereas formerly these winds were a dominant feature of the weather during the months July to October, after which they ceased to be prominent, they are now, though

still particularly marked during that season, common winds throughout the year; and it may thus well be that in this case also, as in that of diminished rainfall, as established by Schumann and Thompson, that "the popular notion is not very far wrong". In confirmation of this, the figures recorded at Middelburg (Cape), reflect that the winds from the western quadrant, although markedly a winter phenomenon, are in truth still important winds of the summer months, attaining frequencies of 20 per cent. and over as deep into the summer as December and January. What their former frequencies may have been is, however, not known.

Unfortunately there is no data available, extending over a long period of years, with which to test these suggestions. It is, however, apparently agreed by meteorologists that denudation of the western regions may produce some change in the diurnal amplitude of wind velocities, although, the opinion seems to be that these regions in South Africa, though vast in themselves, constitute so small an area relative to the earth's surface, that resultant temperature effects of denudation are not likely to produce marked results in terms of increased temperatures or velocieties of these winds. In the absence, however, of data on this subject, the suggestion still stands, although, as pointed out by Professor Schönland, in a recent

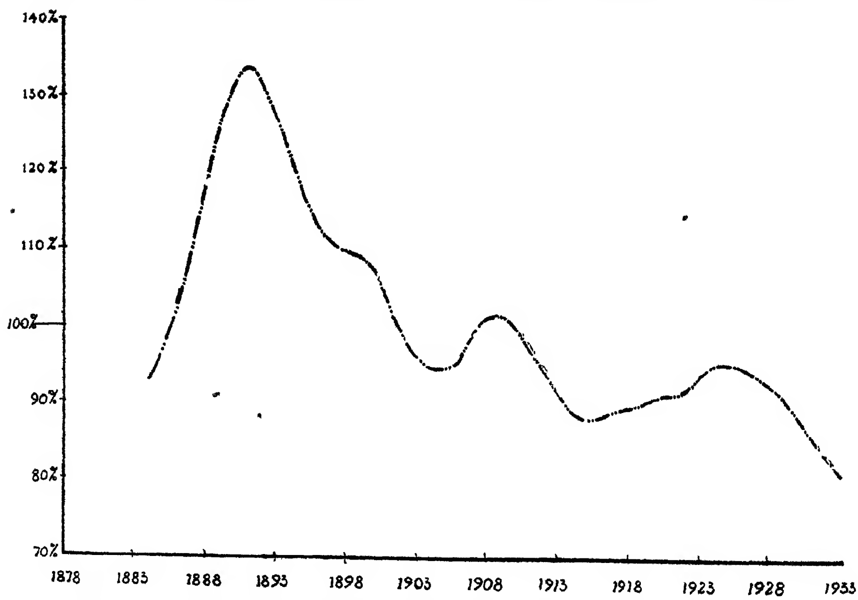


FIG. 7.—(*Graph C*). Smoothed rainfall graph of Region C (Figure 4). (After Schumann and Thompson, 1934.)

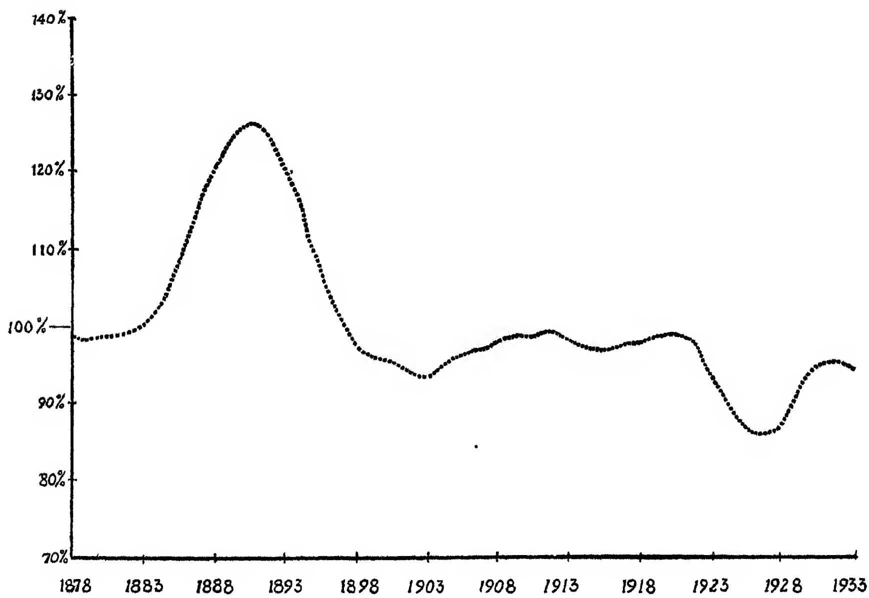
communication, even could it be established that increases in temperatures, frequencies and velocities of the winds had in truth taken place in recent years, it is doubtful whether the causes could be traced directly to denudation of the western areas, and whether these increases were cause or effect of the climatic deterioration, described earlier, would still not be known.

Influence of Grazing Sheep.?

With regard to the conclusions of Schumann and Thompson stated above, namely, that the trends of diminishing rainfall observed in South Africa represent widespread secular variations over the greater part of the southern hemisphere, and are beyond the influence of human agency, it is of interest to note that whereas the coincidence of similar trends in

certain districts of Australia are cited in confirmation of the hypothesis, the trends described in South Africa do not even extend to all districts of this country, and that there was a time lag of approximately 27 years between the beginning of the downward trends in the Cape Midlands and the appearance of a similar decline in Natal, Transvaal and the greater part of the Orange Free State. And further, it may, or may not, be significant that the curves of Figures 4 to 8 (reproduced from the paper of Schumann and Thompson) reflect that the rainfall of district A of the map (Graph A of Fig. 5) has remained virtually constant during the period 1878 to 1933, while that of district B (Graph B of Fig. 6) reflects a distinct downward trend, and that of districts C and D (Graphs C and D of Figs. 7 and 8) shows a steep decline.*

On the hypothesis above, relative to induced climatic deterioration consequent on denudation of the vegetal cover of the western regions, it follows logically that, if the suggestions advanced are valid, the further west we go, the closer the approximation should be to the original climatic conditions. Although possibly a chance coincidence, Figures 4 to 8 substantiate this fully. Figures 5 to 7 present an almost complete series of



FIG, 8.—(*Graph D*). Smoothed rainfall graph of Region D (Figure 4). (After Schumann and Thompson, 1934).

gradations, as will be clearly seen. Further, with regard to the time lag just mentioned, it may be argued that since the Midlands were naturally the drier regions, and the principal sheep areas, they were obviously the first to become depleted, and that only subsequently did the higher rainfall areas of Natal, Transvaal and Orange Free State begin to show the effects of similar depletion. This coincides well also with the history of stock increases in the country, as pointed out by Schumann and Thompson, and it may be pointed out, also, that the Australian districts selected by these authors for comparison with South Africa, together with Victoria, are

* Although the rainfall data for the period 1933 to 1946 is available in the Meteorlogical Office, this data has unfortunately not yet been reduced to a digestible form, and smoothed graphs for this period are therefore not yet available.

the chief sheep areas of that country, and have experienced a very similar history of colonisation and farming to that of South Africa. Again, it may, or may not, be significant that the rainfall decline in these Australian districts set in shortly after the country had attained its peak of stock numbers.

Although the inference drawn here from these coincidences may not be the true one, they are nevertheless highly suggestive, and this line of inquiry might profitably be followed up. The fact that there is no direct evidence available that diminution of rainfall is caused by increase in temperatures, and reduced humidities, resultant on denudation, and that, apart from the possibility of light showers of rain only being affected, meteorologists appear to be rather sceptical of the contention, the possibility is in no way eliminated.

Is Reclamation Possible?

A suggestion that has previously been put forward that reclamation measures should be concentrated in the west, in an attempt to combat the wave of destruction that is passing over the country, is worth consideration. As it would appear, from researches conducted in the Mixed Karoo areas, that the chances of success of attempts, in this region, to halt the deterioration, and restore the vegetation on the existing depleted sub-soils, in the face of climatic deterioration, seem rather slender, the effort and resources involved may initially be more profitably employed elsewhere.

It is submitted, therefore, that a concentration of effort in the far west, combined with a concerted attempt to halt the further advance in the, east, by consolidation of the grassveld along the eastern margin of the Mixed Karoo, and thus a convergence from two sides on the centre, would probably be the most logical approach.

Conclusion.

In all events (even with the provisions of the recent Soil and Veld Conservation Act) it will be evident that, in view of the limited resources and personnel at present at our command, and the virtual impossibility therefore of establishing, in the time required, an effective network of soil and veld conservation throughout the length and breadth of the country, it is essential to determine, at the outset, at what critical points, and in what way, concerted action is likely to have the most effective and far-reaching results. From this it follows clearly that, to enable these decisions, a thorough investigation of the operative factors and true causes of this retrogression should be undertaken without delay. In other words, with this present threat hanging over us, it is imperative that no time should be lost in amassing and collating all possible evidence and data that may have any bearing whatever on this all-important problem.

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Phosphate Studies in Lowveld Soils.*

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SOUTH AFRICAN soils contain, generally speaking, only very low levels of both total and available phosphate. In most areas where intensive cropping is practised it soon becomes impossible to farm profitably without the generous use of phosphates. When it is realized that our farmers spend annually £3,000,000 in purchasing phosphates, the importance of this fertilizer ingredient must be readily conceded.

It is perhaps not commonly known that recovery of applied phosphates in the crop immediately following application, varies from 10 to 30 per cent. of the quantity added to the soil. This statement really applies to the whole world. It is, therefore, not surprising to learn that agricultural scientists throughout the world are constantly studying ways and means of improving this recovery of phosphate by the crop.

Research into the Most Effective Methods of Phosphate Application.

It is of interest to review briefly the lines of research that have been conducted throughout the world. Mixed fertilizers have been injected in solution into the soil within the overhang of the branches of fruit trees; unsuccesful efforts have been made to supply plant nutrients by injecting liquid fertilizers into the trunk of the tree; to counteract the enormous loss in available phosphate in soils of high fixing capacity, numerous workers have compounded the phosphate applied into "nests" or lumps with materials like cement, plaster of Paris, sodium silicate, etc., and achieved noteworthy results. These processes were too costly for large-scale use, but the knowledge gained from these researches probably led to granulation of fertilizers and fertilizer placement to overcome fixation of phosphate.

Most striking results have recently been obtained by several workers who have experimented by coating seeds with mixed fertilizer solutions before planting. These workers have achieved recoveries of phosphate applied in this way of up to 80 per cent. Substantial increases in yields in field trials have been obtained, but the agricultural experts have still a great deal to learn before such methods can be recommended for general use. At the Research Station, Nelspruit, the following three lines of research on the phosphate problem are at present in progress.

(1) Penetration of Phosphate into Soils.

It is vitally important to know the rate of penetration of phosphate in regard to the feeding of all deep-rooted crops, e.g. fruit trees. Citrus soils, at the Research Station, Nelspruit, which have received annual applications of 640 lb. superphosphate per acre for the past nine years were sampled at the 0-3-in., 3-6-in., 16-12-in., and 12-24-in. depths. It was found that the phosphate-treated plots showed very appreciable increases over the "no phosphate" plots up to the 6-in. depth, but only a very slight increase over the 6-12-in. depth, and below 12 in. no measurable increase. The soil is a coarse sandy loam of granitic origin. It can thus be anticipated that the downward movement of phosphate on heavy soils will be still slower.

* Details and further information on this subject can be obtained from the author.

(2) The Fixation of Phosphate in Soils.

The fixation of phosphate, from a laboratory point of view, entails the change from a form soluble in water to one insoluble in water.

The enterprising research of several American agricultural scientists on the relative phosphate-fixing capacities of soils seemed to offer a profitable line of research to elucidate aspects of our phosphate problem. The phosphate-fixing capacities of 8 samples (0-12 in.) of Lowveld soil types, were determined and the results are presented in the accompanying table.

Relative Phosphate Fixation in Lowveld Soils.

Location.	Type of Soil.	Acidity Index pH.	Percentage Fixation (25 gm. soil) (150 mgm P)
Karino	Sandy Loam (granitic)	4·7	1·0
Alkmaar	Sandy Loam (granitic)	5·5	1·0
Nelspruit	Sandy Loam (granitic)	5.0	6.0
Alkmaar	Red Brown Loam	6·1	11·1
Louws Creek	Brown Loam	5·0	14·9
Malelane	Red Brown Loam	7·0	19·2
Schoemanskloof	Grey Heavy Loam	6·0	36·5
Graskop	Red Brown Loam	4·5	69·5

The data obtained from these soils are relative only, as the figures are largely dependent on the soil to soluble phosphate ratio, but they have great value for comparative purposes.

The variation in fixing capacity of the above soils is so considerable that it is obvious that no general phosphatic fertilizer recommendation would serve to cover efficiently a range of soil types differing so widely in their capacity to fix phosphate.

(*a*) *Practical Application by the Use of Soluble Phosphates such as Superphosphate.*—In soils of low fixing capacity (light sandy loams) the application of soluble phosphates, such as superphosphate, to the surface soil around the plant and followed as soon as possible by a good irrigation or rain would produce beneficial results. If, however, the phosphate is left some time on the soil surface without an adequate quantity of water to drive it into the soil, then the efficiency resulting from such an application will be considerably reduced. Therefore water should be applied as soon as possible after surface application of superphosphate to the soil.

(*b*) *Fertilizer Placement.*—The granite soil of the Research Station, Nelspruit, has a fixing capacity of 6 per cent. In the light of practical observations over the last few years it is evident that this fixation is high enough to justify placement of phosphate, i.e. far better results are obtained by the spread along the row method of application as compared with broadcasting or topdressing. In most soil types the heavier the soil, the greater will be the difference between applying in the row and topdressing. In the Malelane area, for example, it was found possible to increase the yield of tomatoes by 1,000 boxes per morgen, by applying superphosphate in the row at planting time as compared with topdressing.

(*c*) *Lime and Phosphate Availability.*—Many agricultural scientists have demonstrated the beneficial effect of lime on availability of phosphate in acid soils. The downward movement of lime in soils has, therefore, to be considered.

Citrus soils, (Research Station, Nelspruit) that have received an annual surface application of agricultural lime over the past nine years were sampled at the 0-3-in., 3-6-in., 6-12-in. and 12-24-in. depths and the samples analysed respectively for total calcium. By comparing the figures so obtained with the " no lime " treatment, it was found that the effective penetration of lime did not exceed 6 in. The downward movement of lime, even in a coarse sandy soil, is thus very slow. Hence it follows that if lime is to be used more effectively to reduce phosphate fixation, then ploughing under should be the rule to ensure that the lime is placed as near as possible to the major root zone of the crop.

(*d*) *Effect of Organic Matter and Legumes on Phosphates.*—In all soils, phosphate fixation will be reduced by incorporating large quantities of organic material such as compost, kraal manure or a green manure crop. It is a well established fact that the roots of legumes have extraordinary powers of breaking down insoluble rock phosphates and thus obtaining their requirements of phosphate. In cases where legumes can be profitably used in a rotation, particularly on soils of high fixing capacity, such as the Graskop type (and this type includes practically all heavy acid soils), it would be sound practice to broadcast cheap rock phosphate and agricultural lime, plough under and then sow to a legume which, when eventually ploughed under, will return to the soil a fairly available and steady source of phosphate for the ensuing cash crop.

(*e*) *Recommendations for Vegetables.*—For vegetable production on acid soils of high fixing capacity, a mixture of two parts of rock phosphate with one part of superphosphate should be tried out, against superphosphate alone and rock phosphate alone. In all cases, generous applications of the phosphate in the row at the 4-5-in. depth, to avoid excessive mixing of phosphate and rock, are tentatively proposed. Several large-scale plantings of tomatoes along these lines indicate that the above suggestion is sound, but it remains to be proved if this will apply to each and every crop. Farmers are requested to do a little experimenting along these lines and determine for themselves what form of phosphate to use, how deep to place in the row and whether it should be placed in one band or two parallel bands. Certain seeds, cotton and groundnuts in particular, are very sensitive to fertilizer burn. Placement of fertilizer normally implies placing the fertilizer some 2 in. below the level of the seed.

(*f*) *Phosphates and Tree Planting.*—It is apparant from the foregoing remarks that neither phosphate nor lime possess powers of moving rapidly downward through soil and it thus becomes difficult to feed deep-rooted crops, particularly in heavy acid soils. Several investigators have overcome this problem by making 6 to 12, 1 in. diameter holes around a tree, using a length of round rod and placing solid fertilizer—such as lime plus rock phosphate—into the hole to within 6 in. of the top and sealing with soil.

All deciduous and subtropical fruit-tree plantings on all soil types should receive applications in the hole at planting time of from 2-10 lb. of cheap rock phosphate (say 2 lb. for every five years anticipated economic life of the plant). If lime is necessary it could, to great advantage, be applied at the same time in admixture with rock phosphate.

(*g*) *Supplementing Rock Phosphate Application with Agriculture Gypsum.*—The substitution of rock phosphate for superphosphate is likely to create another problem. Superphosphates contain about 50 per cent. of gypsum. The respective solubilities of agricultural lime and gypsum have been determined and gypsum found to be 130 times more soluble than agricultural lime.

This, then, accounts for the fact that an application of superphosphates invariably leads to an increase in the percentage of calcium in the crop, indicating the high availability of the calcium in the gypsum.

Superphosphates thus supply to the soil available phosphates, a comparatively soluble form of calcium, and in addition sulphur as sulphate iron—the form in which it is required by plants. Numerous workers have indicated that quite a large number of plants remove from the soil as much sulphur as phosphorus. To forestall trouble that may arise from sulphur deficiencies, farmers are advised to supplement rock phosphate applications with half their weight of agricultural gypsum.

(3) Different Forms of Phosphate.

The relative availability of superphosphate, ammonium phosphate, Gafsa, and Langfos has been determined in a pot experiment at the Research Station, Nelspruit. Sandy loam of granitic origin (pH 5) was used for this experiment. Quantities of the above-mentioned fertilizers, based on the total phosphate in the respective fertilizers were weighed out and thoroughly mixed with 30 lb. of soil. After periods of one day, one week, three weeks, and nine weeks respectively, representative samples were withdrawn for analyses of available phosphate. The experiment was laid out as a randomized block experiment using four replications. Phosphatic fertilizers were given to each pot to a depth of 6 ins. at a rate equivalent to 500 lb. superphosphate per acre (18·5 per cent. P_2O_5) for the low series and five times this quantity for the high series.

In addition to the above, single-pot treatments were included in this investigation to ascertain the effect of sulphur on rock-phophate availability. The higher level of rock phosphate was used and an equal weight of sulphur added. To the high level of superphosphate, Gafsa and Langfos, respectively, 200 gm. of kraal manure was added (ration 10 kraal manure to 1 phosphate) in order to determine whether this addition would increase or prolong the availability of the phosphates concerned. Kraal manure only has been used to determine what availability of phosphate from this source may be anticipated.

Interpretation of Results Obtained.

In the low series the two rock phosphates have proved superior to the soluble phosphates. This is no doubt due to the fixation of the comparatively small quantities of soluble phosphate used. In the high series superphosphate has proved superior to all the rest. It appears as if there has been sufficient superphosphate to saturate the soil-fixing mechanism leaving the balance in a readily available form. The reaction of ammonium phosphate in this soil type is not understood, but its performance as a phosphatic fertilizer is most disappointing. Its use on this soil type cannot be recommended. The analytical results indicate that a mixture of two parts of rock phosphate to one part superphosphate ought to produce excellent results in field trials. It must, however, be borne in mind that the use of rock phosphate necessitates placement of fertilizer. It is the opinion of the writer that the disappointing results following the use of rock phosphate in the past has been largely due to the then universal practice of broadcasting and harrowing in. It is suggested therefore to apply the phosphate mixture in the row at planting time, at a depth suitable to the particular crop, and aim to get the mixture as near as possible to the main root system of the plant.

The effect of sulphur on rock phosphate availability led to a slight increase for the first three weeks. This effect fell away and at the end of the nine-week period the availability of phosphate was actually considerably lower in the sulphur treatment. It is probable that the increase in soil acidity, due to sulphur, increased the natural phosphate-fixing properties of the soil. The use of rock phosphate-sulphur mixture on this soil type is condemned.

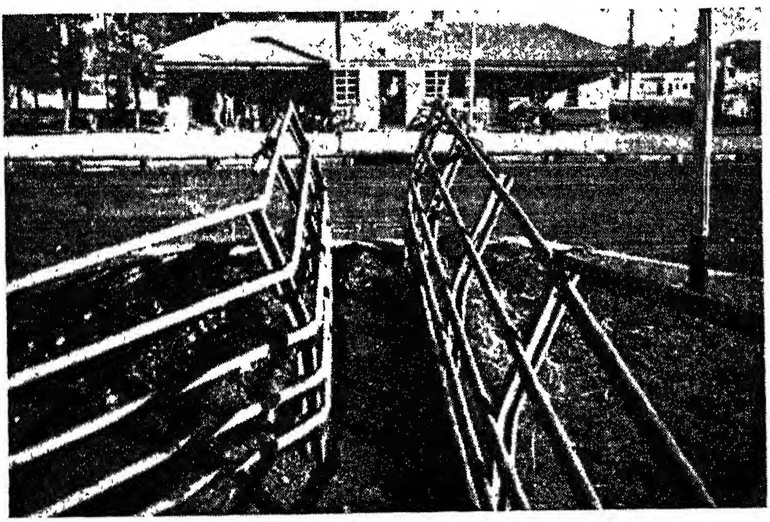
 [*Continued on page* 576.

Weight Losses in Slaughter Stock During Transit.

J. S. Starke, Professional Officer (Sheep and Wool), Agricultural Research Institute, Pretoria.

CONSIDERABLE friction between farmers, agents and railway authorities has already been caused by the problem of weight losses when farm stock are despatched to the large abattoirs for slaughter. This problem has now become accentuated, since the producer is being paid according to the dressed weight and grade of his slaughter stock.

Farmers in general are under the impression that long delays in the time between despatch from the farm and slaughtering result in financial loss to the producer as a result of loss in carcase weight, as well as deterioration in grade. Accordingly it is felt that the available information (*) should be brought to the attention of those concerned with the marketing of slaughter stock.



A useful loading pen at the Silverton railway station.

That a loss in live-weight does occur when stock are transported from farm to abattoir, is generally accepted. The question now arises as to the extent and precise nature of the loss, and how much it affects the weight and grade of the carcase.

Influence of Fasting on Weight Losses.

Of the various factors that may have an influence on weight losses, the period of time that the animal has to fast before being slaughtered is the most important. Since it is an accepted principle that animals should be starved for about 24 hours before slaughtering, we are mostly concerned with delays in slaughtering periods longer than 24 hours.

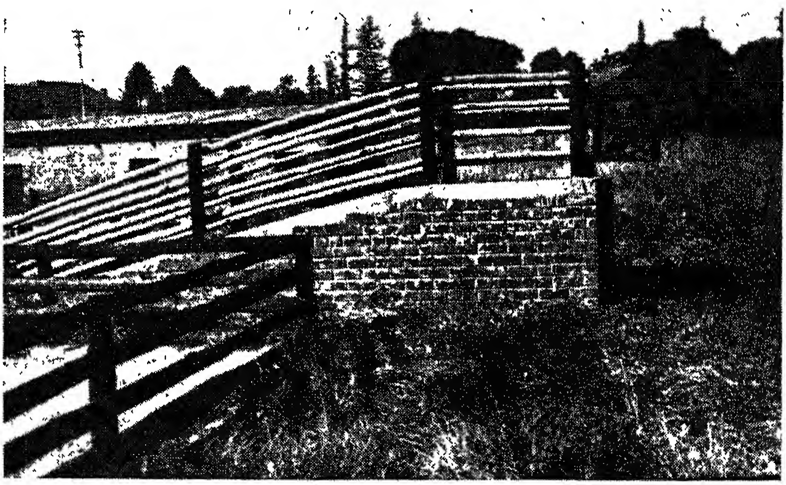
From a review of the literature on weight losses in slaughter stock with fasting it is possible to come to certain conclusions.

* A bulletin giving greater details on this subject has been submitted for publication.

Firstly, it is evident that with an increase in the period of fasting before slaughtering there is an increase in the loss of live-weight. This loss is mainly due to a loss in the contents of the digestive tract, which are of no economic value. There is, however, also a lesser loss in weight of the carcase itself and in certain of the offal organs, viz., the liver and the empty stomachs and intestines as well as the mesentery.

The extent of the loss in live-weight appears to be about 3 to 4 per cent. of the farm live-weight per day. In the case of sheep and cattle the loss is apparently greater during the first 24 hours than subsequently, due mainly to the more rapid decrease in the contents of the digestive in the early stages of fasting.

The loss in carcase weight would appear to be about 3 per cent. of the carcase for each day of fasting in the case of pigs, an average of 1·5 per cent. for lambs and possibly even less for cattle. It is probably only after the first day of fasting that an appreciable loss occurs in the carcase of sheep and cattle. A large portion of the loss in carcase weight has been attributed to a loss of moisture from the flesh, which would normally occur after slaughtering and with storage. Accordingly this does not represent a loss in nutritive value of the carcase.



Loading ramp used at the farm of the Agricultural Research Institute, Pretoria.

There is apparently no deterioration in appearance and grade of carcases with a delay in slaughtering, even up to four days in the case of fat lambs.

The Effect of Transport on Weight Losses.

In addition to the period of fasting, the distance travelled and nature of the journey also have an effect on weight losses. The more animals are disturbed and upset, the greater will be muscular fatigue, with a consequent greater loss in carcase weight.

Where payment is made according to dressed carcase weight, loss in transit does represent a slight economic loss to the farmer. This can be minimised to a large extent by speeding up the transport of slaughter stock to the abattoirs and by upsetting the animals as little as possible. This requires proper handling and loading of the slaughter stock and protection from extreme weather conditions. It is doubtful whether the feeding and watering of stock on short journeys is of value. Slaughter stock should

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Textile Fibres.

J. C de Klerk, Professional Officer, (Sheep and Wool) College of Agriculture, Glen.

FOR his existence, primitive man was dependent on two essential requirements, namely, food for maintenance, and protection against the cold and whims of Nature. In the earliest days he depended on the chase for his food; with the meat he could satisfy his hunger and with the skins of the animals he killed, he could clothe himself. As man developed and became more civilized, he learned to grow not only his food, but also fibres, be it wool, hair or plant fibres, to meet his clothing requirements.

In modern times we take the existence of these fibres as so much for granted, but if it is considered how many people in the world are directly or indirectly dependent on fibres for their livelihood and how indispensable fibres are for every civilized person, their tremendous economic importance will be more fully appreciated.

Wool and hair are among the first fibres usefully applied by man, and wool was already being spun and woven before the advent of written history. The ancient Egyptians, Babylonians, Greeks and Hebrews had home-made spinning and weaving frames, and woollen clothing was the principal dress of the Romans.

The history of the sheep and its wool is undoubtedly a tale of adventure, sacrifice and resourcefulness. From primitive beginnings, wool-growing has developed into a gigantic industry. Many countries owe their progress and wealth largely to wool, and it is said that sheep made England, and that civilization began when man first learnt to shear sheep.

In so far as many of our farmers are dependent for their existance upon the wool they produce and export, South Africa has great economic interest in fibres. On the other hand, the Union is largely dependent upon foreign countries for this very fibre in the form of manufactured articles. It may be of interest to state here that the import value of textile goods to South Africa for the last few years was as follows:—

1942	£26,366,415.
1943	£27,795,158.
1944	£30,685,202.
1945	£34,184,972.

Requirements of Textile Fibres.

The term textile fibres denotes both natural and artificial fibres capable of being spun into a thread which may be used either as such or woven into textile fabrics. Textiles are understood to denote woven, knitted and felted fabrics such as clothing apparel, carpets, canvas, bags, etc.

The physical properties of a fibre determines its usefulness in the manufacture of certain articles, and of these properties the following are the most important:—

(1) Length and uniformity of length.

(2) Fibre fineness.

(3) Tensile strength, i.e. the resistance which a fibre on being stretched can offer before breaking.

(4) Pliability, which admits of the fibres being spun into yarn without their showing a tendency to untwist when the tension is released.

(5) Elasticity, i.e. the ability of the fibre to return to its normal length after having been stretched.

(6) Lustre.

(7) Durability, which enables a fibre to give long and useful service.

(8) Conductor of heat. This property in wool makes a woollen article a poor conductor of heat and accounts for the wearing of woollen clothing materials for their heat retaining properties in cold weather. Flax and linen are relatively good conductors of heat and are therefore suitable for light summer wear.

(9) Ability to absorb moisture.

Classification of Textile Fibres.

Fibres may conveniently be classified under two heads, namely:—

A. *Natural Fibres,* consisting of:—

(1) Fibres of *animal* origin, as wool, hair, pure silk, mohair, camel hair, llama, alpaca, vicuna hair, cashmere, etc.

(2) Fibres of *vegetable* origin, as cotton, flax, hemp, jute, ramie, sisal, coconut fibre etc.

(3) *Mineral* fibres, as asbestos, glass and certain metals.

B. *Artificial or synthetic* fibres, which may also be sub-divided according to their origin, for example:—

(1) Those chiefly derived from cellulose or wood pulp by chemical processes and which are usually known by the American term "Rayon". Thiele, Viscose, Chardonnet and Celanese belong to this group.

(2) Those consisting of synthetic plastic products derived from coal, petroleum products, acetylene, and formaldehyde. Nylon is the best known. Vinyl is another.

(3) Those made from protein material of vegetable or animal origin, as e.g. lanital and aralac from the casein of milk, sarelou and ardil from the protein of groundnuts. From the "Zein" protein of maize, the protein of soybeans and the Keratin protein of fowl feathers, such synthetic fibres are also made. These processes are costly.

Identification of Fibres.

In their pure state, fibres are usually readily distinguishable, but the difficulty arises when they appear in manufactured form and especially in mixtures. For example, an article made of fine merino wool is most difficult to distinguish by sight alone, from a product of the same quality wool with an admixture of artificial silk.

Identification is further hampered by the fact that most fabrics are dyed, as a result of which certain fibres lose their typical group reactions by which they may be easily recognised. Dyes can be removed from the fibres, but this is not always easy, since some dyes are very fast and if the fibres are treated too drastically, their chemical composition may be changed entirely.

Identification may be further complicated; for example, when cotton is treated with caustic soda (Mercerised cotton is obtained in this way) it

loses some of its original properties and acquires new characteristics which may cause it to be confused with artificial silk.

When textiles are, therefore, bought over the counter, the buyer must rely either on what the merchant bought it for or on the information on the label, if any. For all practical purposes there is no simple method of immediately testing the fibre-genuiness of a purchased article.

Under more favourable circumstances the identification of the commonest fibres is, however, not impossible. The simplified methods given here do not claim to identify all the different fibres, but are designed merely to outline the types of fibres.

Carefully separate the warp from the weft threads, for quite frequently it is found that in woollen fabrics the one is cotton thread or artificial silk and the other a woollen thread.

FIG. 1.—Typical South African merino ewes producing wool of high quality.

Difference between Animal, Vegetable and Artificial Fibres.

Test.	Animal Fibres.	Vegetable and artificial fibres of cellulose origin.
1. Burn the fibres.......	They burn slowly and leave a bead ; smell of burning feathers or horn.	Burn readily; leave no bead, and the ash is grey.
2. Heat fibres in a glass tube.	They smell of burning horn. Ammonia is given off, which changes wet red litmus to blue.	They smell of burning paper; no ammonia is given off.
3. Hold over the open end of the glass tube in which the material is being heated, a piece of filter paper which has been wetted in a lead acetate solution.	If it is wool the paper will become black. If silk, it will not turn black.	

Lanital and Aralac, which are also manufactured from animal protein matter, burn very much like wool and leaves a bead. Microscopically, however, they can readily be distinguished from wool by the absence of the characteristic serrations or scale formation so peculiar to wool, especially fine wool. Nylon, on the contrary, does not burn at all; it melts rather than burns.

Difference Between Vegetable Fibres and Artificial Silk.

With the aid of certain chemicals, artificial silk may be distinguished from vegetable fibres. Artificial silk is often glossy, which is characteristic of certain fabrics such as taffeta and satin, but should not be confused with mercerised cotton which is also fairly glossy. This glossy appearance in artificial silk is not always consistent, especially when the material has already been dyed. When deprived of its lustre, it very much resembles cotton.

Under the microscope, however, artificial silk or rayon may be readily distinguished from vegetable fibres as follows:—

(*a*) Rayon lacks the typical cell structure peculiar to vegetable fibres.

(*b*) It does not possess the lumen or air-space so characteristic of vegetable fibres.

(*c*) The ends of artificial silk fibres are blunt where it is cut to change it from a filament form into short fibres of the desired length in order that it may be mixed with other fibres. Artificial silk is, naturally, also found in filament form, in which state it is readily recognisable.

(*d*) If the material is firmly pressed in the hand, cotton fabrics will usually crease, whereas artificial silk is more crease-resistant, especially when specially treated or "tebilized" for this purpose.

(*e*) Fabrics manufactured from vegetable fibres are more difficult to tear when thoroughly wet than when dry.

Artificial Fibres and Their Uses.

The manufacture of artificial fibre began in France when Hilaire de Chardonnet in 1890 for the first time manufactured artificial silk on a commercial scale. Its manufacture spread rapidly to other industrial countries and from a humble production of 8,900 tons in 1909-13, it reached the peak of 1,281,577 metric tons in 1941. (Compare with world production of wool in the grease: 1·7 million metric tons during 1934-38).

This amazing expansion in the manufacture and consumption of artificial silk thread during the last 40 years was made possible by technical improvements, a growing interest and confidence on the part of consumers resulting in ever-expanding sales of this new product brought about by education of the consumers in the uses and properties of artificial fibres; the trend of fashion (which always clamours for lighter fabrics) and a steady and relative fall in the production costs.

These technical improvements have succeeded in making artificial silk a fibre of many uses, which is steadily ousting natural fibres. This product may be used for the manufacture of fabrics of virtually every weave or texture or variations of basic weaves. It may be mixed with cotton or wool or used independently for making such well-known fabrics as rayon, flannel, serge, tweed, crépe, satin, taffeta, ninon, moire, afghalain, brocade, georgette, rayon linen, knitting yarn, etc.

This popularity of artificial silk must be ascribed largely to the fact that extremely light fabrics, which make so strong an appeal to feminine taste, may be made from it. As against wool, flax and pure silk, it is inexpensive. It is comparatively crease-resistant if well manufactured and it has good draping qualities, which must be regarded as very important.

Certain artificial silk fabrics are certified for their construction, crease-resistance, colour fastness, tensile strength, etc., and the consumer may

enquire and know exactly what he or she is buying. It washes well, is moth resistant and the plastic fibres, such as nylon and vinyl, are not inflammable.

It must, however, be emphasized that artificial silk is no substitute for wool. Like all other fibre, it is not perfect and has its defects. In some of its properties it excels the natural fibres, but no artificial fibre has ever been made to surpass wool in *all* its properties.

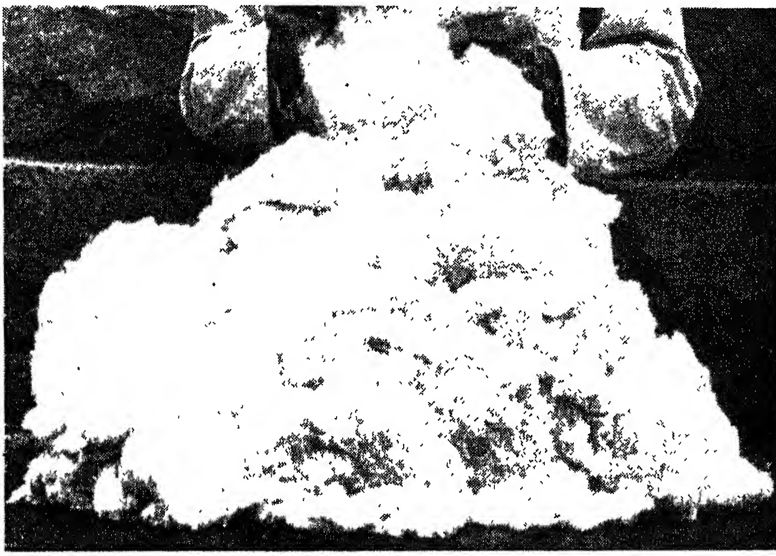

FIG. 2.—Cotton does not occur in staples and differs greatly from wool, e.g. in fibre thickness, lustre, length, etc.

Characteristic Properties of Vegetable Fibres.

1. (*a*) Cotton:
   - (1) Burns away, leaving no bead.
   - (2) Turns black in iodine, but the black colour washes out again.
   - (3) The fibres are flat and twisted.
   - (4) Shows a characteristic lumen.

   (*b*) Mercerised cotton:
   - (1) Burns away, leaving no bead.
   - (2) The number of twists in the fibre is much reduced.
   - (3) The lumen is much smaller and the walls of the fibre thicker. The term "mercerised" cotton is derived from the name of its inventor, John Mercer, who, by treating cotton with caustic soda, made the fibres shrink as well as acquiring new characteristics, e.g. greater strength, a higher capacity for absorbing moisture and dyes, and a more glossy appearance.

Uses and Properties of Cotton.

Cotton is the world's most important vegetable fibre, and a world without cotton is to-day inconceivable. Of all fibres it is the most adaptable and can be used for the manufacture of practically any kind of article, from the softest cotton-wool and baby clothes to canvas and rope. Cotton fibre is used for making clothing of all descriptions, for overalls,

overcoats, upper and under garments, curtains, bed-sheets, towels, handkerchiefs, pajamas, socks, neckties, light summer clothes in a variety of forms for both men and women, shirts, fishing lines, bags, covering for aeroplanes and motor cars, canvas for tennis shoes, etc.

Cotton is a very strong and durable fibre. One has but to think of the proverbial khaki shirt and trousers to appreciate the wearing qualities of this fibre. which may well be said to be one of man's best friends. If science should ever succeed in making all cotton fabrics crease-resistant (there are already rumour that this is the case) it would undoubtedly make this fibre still more popular.

2. *Flax or Linen*:

(1) Burns away, leaving no bead.

(2) When the fibres are unravelled and held to the light, they have a slightly glossy appearance.

(3) Under the microscope the fibres are very thin and have certain characteristic marks which reminds one of the nodes of a maize stalk. The ends of the fibre taper to a sharp point like a whip.

Uses.

Linen is a bast fibre obtained from the flax plant. Flax was cultivated for its fibre by the oldest civilizations as far back as 2500 B.C. and was utilized long before wool or cotton. It is a particularly strong fibre, conducts heat fairly well, washes well and can absorb as much as 12 per cent. moisture. It is exceptionally durable, as all housewives who are acquainted with Irish or English linen and linen damask will testify.

Among the commonest articles made of flax or linen may be mentioned fishing lines and many kinds of linen material such as genuine sheeting linen, handkerchiefs, serviettes, tablecloths, mats, waterbags, covers for benches, chairs and aeroplanes, fire hoses, motorhoods, canvas, cobblers' twine, etc.

A peculiarity of the textile trade is the terminology used in reference to many kinds of "linen" material which have no connection at all with genuine linen made of the flax fibre. For example, there is "dress" linen, which is made of artificial silk; "sheeting" linen and "bleached" and "unbleached" linen (calico) which are made of cotton, and ordinary linen material manufactured from artificial silk and cotton.

The origin of the use of the word "linen" in connection with these fibres, which have nothing to do with flax (unless it denotes a particular weave structure) is not clear, and probably it is customary for the housewife to ask for English or Irish linen if she wishes to have material made from flax fibre.

3. *Genuine Hemp* (*Cannabis sativa or* Dagga).

(1) Burns away, and leaves no bead.

(2) Lumen very wide.

(3) Ends of fibres blunt.

Hemp is a bast fibre obtained chiefly from India and Persia. Unlike flax, this fibre is not of uniform thickness.

It is used chiefly for making ropes, bags, sail cloth, canvas, fire hoses and packing material.

4. *Jute.*

(1) Burns away, leaving no bead.

(2) Lumen not uniform and in parts even absent.

(3) Fibre tapers.

(4) The "X" markings typical of flax and hemp are absent.

Jute is also a bast fibre produced chiefly in India. Next to cotton, it is the most extensively cultivated fibre in the world, and is generally used for making wool and grain bags, ropes, carpets, etc.

5. *Other vegetable fibres.*

In addition to the vegetable fibres already mentioned there are other important fibres of vegetable origin such as ramie, which is extremely strong and used mainly for making fishing nets.

Sisal is used largely for making very strong ropes. The most recent addition to the known group of bast fibres is the wild hollyhock which will help to supplement the serious shortage of fibre for bags in South Africa.

Coir and kapok, although they take a modest place next to other vegetable fibres, are nevertheless important and valuable.

Analysis of Mixed Fabrics.

The percentage of foreign fibre present in woollen fabrics, may be determined as follows:—

(*a*) *Determination by weight.*—Some fabrics are obtained by using woollen warp and artificial silk or cotton weft threads. Take a piece of material 2 ins. square, and carefully separate the warp from the weft. Each

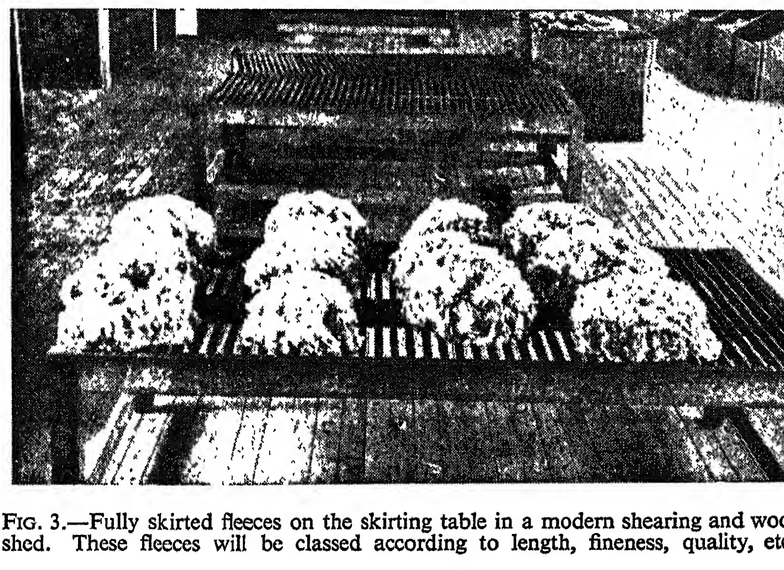

FIG. 3.—Fully skirted fleeces on the skirting table in a modern shearing and wool shed. These fleeces will be classed according to length, fineness, quality, etc.

is then carefully weighed on a dry-weight basis and the respective percentages determined. The material was, of course, not originally mixed on a dry-weight basis and, since the capacity of different fibres to absorb moisture varies, it is desireable to adjust the result to the international standard of 65 per cent. relative humidity, as follows: (*a*) for wool 15 per cent., (*b*) for cotton 8 per cent. and (*c*) artificial silk (excluding acetate artificial silk) 12 per cent.

(*b*) *Determination by dissolution.* (1) *The Caustic Soda method.*—In most fabrics, the wool and cotton or artificial silk fibres are mixed in the same thread, and determination by weight cannot be applied. The method now adopted is as follows: Take a piece of material, 2 ins. square, and

first determine the weight on a dry basis. Then slowly boil the sample for 25 minutes in a $2\frac{1}{2}$ per cent. solution of caustic soda. This will destroy all wool and animal fibres. After determining the dry weight of the residue, the percentage of each constituent may be determined and again adjusted to 65 per cent. relative humidity as stated before.

Dry wool absorbs moisture very rapidly, and in the dryweight determination it is therefore desirable to weigh the material in stoppered bottles previously weighed. This method has the disadvantage, however, that a small proportion of the cotton will dissolve as well as quite a conceivable percentage of artificial silk fibers. For the elimination of these defects, therefore, the sulphuric acid method is usually preferred.

(2) *The Sulphuric Acid method.*—The material is first thoroughly disentangled by pulling apart all the threads. It is then placed in concentrated sulphuric acid of specific gravity 1·67 and left for at least 2 hours. This will destroy cellulosic fibres, but the wool fibres will remain undamaged. The adjustment of the result to the correct moisture content is again done as indicated above. The residue should invariably be subjected to microscopic examination in order to determine whether or not the fibres have been completely destroyed and whether there are other foreign fibres present.

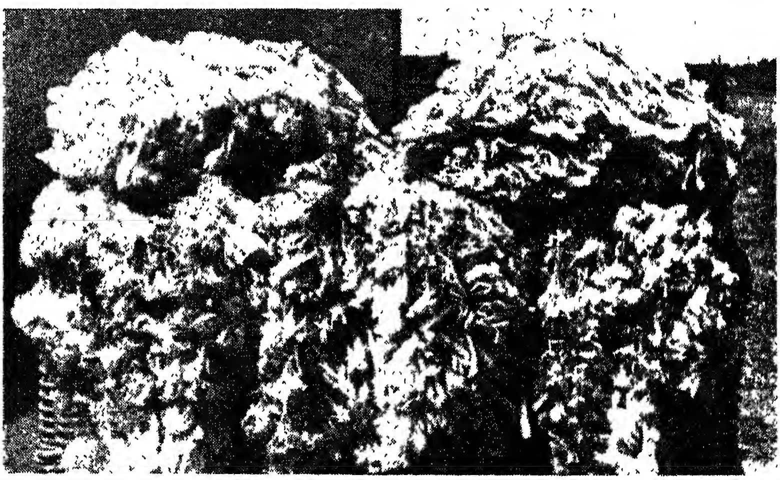

FIG. 4.—Fleeces in baskets before baling. Note the distinct staple formation. Good length merino wool is from 3—4 ins. long.

Although the microscope is indispensable for indentifying fibres, the percentage of each type cannot always be reliably determined by this means and for this purpose recourse is had to chemical means.

General Remarks on Wool as a Textile Fibre.—Of the best type of present-day clothing material is manufactured entirely from pure wool. For speciality products manufacturers use fine merino wool which possesses such desirable characteristics as fineness of fibre, wave or crimp formation, good spinning and weaving qualities, and a soft, full handling and attractive appearance. It may be mentioned here that South African wool is much sought after for the manufacture of "saxony" sports fabrics giving the material certain desirable qualities peculiar to South African wool.

Fine merino wool is still the best fibre for the manufacture of felt material for hats, washers, cloth for billiard tables, etc. This felting quality of fine wool is unique and no other fibre possesses it in the same degree.

Other outstanding characteristics of woollen fabrics are their durability, warmth-retaining properties, high moisture absorption capacity which exceeds that of all other fibres, and that peculiar property of giving off heat to a greater degree than any other fibre while absorbing moisture. In addition pure woollen fabrics are crease-resistant; they drape extremely well, which in the modern world of fashion must be regarded as of the greatest importance.

The outstanding characteristics of wool may be summarized as follows:—

(1) It is a natural body covering.
(2) It is thermostatic or heat-retaining.
(3) It is porous and absorbent.
(4) It is fire-resistant.
(5) It is elastic and resilient.
(6) It is strong and durable.
(7) It is soft and light with a specific gravity of only 1·30 as against 1·25 of pure silk.

The disadvantages of woollen fabrics, namely, in that it shrinks, irritates sensitive skins and susceptibility to moth-damage, have already been successfully overcome by science, although it is an open question to what extent and how effectively the fruits of science are applied in commerce.

FIG. 5.—Rayon artificial silk is manufactured from wood-pulp or cellulose, of which the Spruce tree (*Picea*) is the chief source.

Any wood-pulp of high alpha cellulose content i.e. cellulose which will not be dissolved in 17½% caustic soda within 30 minutes at ordinary room temperature, is suitable for rayon manufacture. In this respect cotton is highly suitable with an alpha content of 98%.

The fact remains, however, that the public to-day is wool-conscious and that wool is a very popular fibre. If its defects can be effectively eliminated, its popularity should be much greater.

It is impossible to distinguish, on sight alone, between genuine woollen fabrics and those mixed with other fibres, especially certain artificial silks. For this reason the American Government passed a law requiring the wool content of all fabrics to be indicated. Similar legislation has been enacted in Australia, and the Union of South Africa is about to follow suit. The reasonable and justifiable demands of South African wool producers in this connection, will therefore, it is hoped, soon be satisfied.

Acknowledgments.

The author would like to thank the Wool Research Institute, Onderstepoort, and the South African Bureau of Standards, Textile Division, Pretoria, for useful guidance.

The hearty co-operation of a large number of merchants in Bloemfontein and elsewhere, who so obligingly provided him with samples and made this study of textiles possible, is also gratefully acknowledged.

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Control of Eelworm:–

[*Continued from page* 516.

(2) Healthy plants have a better chance of producing a crop in infested lands, than infested plants.

(3) By keeping the lands clean and transplanting healthy seedlings, higher yields of good quality may be expected; with infested plants this is not possible.

The profit per morgen can be appreciably raised by using healthy plants.

(4) If the soil is free from injurious bacteria and fungi, permanent seed-beds can be established. In such a case it may be desirable to lay out two series of seed-beds, so that one series may rest every alternate year. Further, it is desirable to destroy the unused seedlings immediately after the useful seedlings have been transplanted.

(5) D-D must not be applied if the ground temperature at a depth of 8 inches is below 40° F. or above 70° F.

Weight Losses in Slaughter Stock During Transit:–

[*Continued from page* 536.

preferably be transported by special trains which should be speeded up as much as possible to avoid the need for feeding and watering. However, on long journeys detraining for watering, feeding and exercise should still be done after every 48 hours of travelling. Good quality hay should be used for this purpose.

On arrival at the abattoirs it would appear to be advisable to give slaughter stock a rest in order to overcome muscular fatigue. During this period the animals should have access to water and if held over for any length of time before slaughtering, they should also be given some feed of good quality. Not only will the feed assist in calming the animals, but it will also provide some nourishment where slaughtering is delayed.

There is, however, a need for further large-scale trials under accurate control on this problem of weight losses in slaughter stock during transit, particularly in the case of cattle.

The Nicotine Content of Tobacco.

C. F. van Rooyen, Senior Technical Officer, Division of Agricultural Education and Research.

THERE are about one hundred different species of the Nicotiana genus to which the tobacco plant belongs. Of all the species only *Nicotiana tabacum* and *Nicotiana rustica* are of any importance as commercial sources of nicotine. *Nicotiana tabacum* is cultivated in all the tobacco producing areas of South Africa for smoking purposes. *Nicotiana rustica* on the other hand, is found here, but cultivated by natives on a very small scale only.

As a result of considerable nicotine research in other parts of the world, it has been established that a whole series of related alkaloids are present in the tobacco plant together with nicotine, and that the term "nicotine" often includes all the other alkaloids. In any case, nicotine, as such, is the most important of the group and predominates in tobacco.

One of the alkaloids discovered later was anabasine. It was found in *Nicotiana glauca,* a wild tobacco plant, in which it constituted the most important alkaloid. *Nicotiana glauca* contains no nicotine.

Some of the nicotine in tobacco appears in combination with various organic acids, while some is present as free nicotine. This portion is volatile in steam, but the fixed portion becomes volatile only when released by alkalies.

Use of Nicotine.

The poisonous properties of nicotine and its use as an insecticide have been known since 1859. At present it is used not only in the control of such insects as aphids, fowl lice, internal worms in sheep, etc., but also *inter alia* for fumigating conservatories, for codling-moth control, in dipping tanks against the arsenic resistant tick, etc.

The commercial product contains 40 per cent. nicotine in the form of sulphate, but there are quite a number of other preparations of varying nicotine content on the market.

All the nicotine used in South Africa has to be imported at a high cost since no nicotine for commercial purposes is produced in the country. Consequently, during the war years there was an alarming shortage here.

The new synthetic insecticides, D.D.T. and Gammaxane which made their appearance during the war and received much prominence, may possibly curtail the use of nicotine, but their full value still has to be proved experimentally. Up to the present it would appear that these two insecticides will be able to replace nicotine in the control of aphids in certain cases only, since they are not effective against all species of aphids. Despite their efficacy, the use of these two insecticides will probably be limited to a great extent in as much as they may be injurious to vegetation and poisonous to man and beast.

Nicotine Content of Tobacco.

Nicotine begins to form in the tobacco plant shortly after the seed has germinated, and the percentage increases, as the plant grows up to the ripening stage when it reaches its maximum.

It has been established that the quantity of nicotine in the different parts of the plant varies considerably. The largest quantity is in the ripe leaves, while the stem and roots contain but little. Usually there is more nicotine in the upper than in the middle and lower leaves, which indicates that nicotine is produced in the growing portion of the plant. The flower-buds contain considerably less nicotine than the leaves. A high nicotine content is usually coupled with a high nitrogen percentage in the leaves, and dark tobacco has a higher nicotine content than yellow or light tobacco.

The nicotine content differs in the different tobacco varieties. The heavy tobacco types, cultivated at the Rustenburg Tobacco Research Station, contain from 3 to 5 per cent. nicotine, while an analysis for content of lighter types discloses less than 1 to 2 per cent. Of all the tobacco species *Nicotiana rustica* usually has the highest nicotine content. During the 1944-45 season a sample of Rustica, grown in red alluvial soil for nicotine experiments at the abovementioned station, acquired a nicotine content of 12·57 per cent. on a dry basis for the whole plant. In Germany a Rustica species was bred which contained 16 per cent. nicotine, and other sub-species were bred which contained very little or no nicotine.

The nicotine content of any tobacco species is influenced by such factors as soil fertility, fertilization, climate, drying processes, cultural methods, etc.

Fertilizers.—Theron and Cutler found that even where large quantities of nitrogen were applied to the soil, the increase in nicotine was much less than when a full (N.P.K.) fertilizer mixture was administered.

Research workers in Canada have found that a reliable increase of nicotine in cigarette tobacco resulted from increased applications of K_2O, while an increase in phosphate applications had little or no effect on the nicotine content of the tobacco. In the U.S.A. an appreciable increase in the nicotine content has been obtained by a large application of nitrogen to the soil.

The result of an experiment conducted during the 1941-42 and 1942-43 seasons at the Rustenburg Tobacco Research Station with the different fertilization mixtures showed that the addition of 38·2 lb. P_2O_5 plus 50 lb. K_2O plus 40 lb. inorganic and 24 lb. organic nitrogen plus 40 lb. inorganic nitrogen for subsequent surface fertilization, in comparison with 38·2 lb. P_2O_5 plus 50 lb. K_2O per morgen, raised the nicotine content of Rustica from 4·31 per cent. to 5·82 per cent.

Climate and Soil Types.—Research workers overseas declare that nicotine content varies with soil and climatic conditions, and that in temperate regions of average rainfall and temperature, the percentage is considerably lower than in tobacco cultivated in hotter and drier areas.

It was found at the Rustenburg Tobacco Research Station, that the nicotine content of Rustica grown during different seasons and treated with the same fertilizer on the same soil types, varied as follows:—

1943-44—5·68 per cent. nicotine (average).

1944-45—8·61 per cent. nicotine (average).

1945-46—4·52 per cent. nicotine (average).

It would appear, therefore, that the nicotine content of the tobacco was indeed influenced by the season.

Concerning the influence of the type of soil on the nicotine content, the following data, obtained by this research station during the 1942-43

season with the same species of tobacco under the same artificial fertilization treatment are given.

Species.	Soil type.	Per cent. Nicotine (Dry basis).
Madole	Red alluvial	2·29
Madole	Grey alluvial	4·45
One Sucker	Red alluvial	2·16
One Sucker	Grey alluvial	5:33

The standard of fertility of the two soil types was unknown and the differences in nicotine content, therefore, cannot be definitely ascribed to the soil.

Method of Curing and Fermentation.

Experiments have shown that most nicotine is lost in the air-curing of tobacco. The reason for this is probably, that the plants, after being cut and suspended, continue to grow to some extent and utilize some of the nicotine for sustenance.

At the Hartebeestpoort Agricultural Research Station various methods of curing were applied to the tobacco variety, namely Western Dark Nyasa. The leaves were cured separately and also when attached to the plant. The results indicate that with air-curing as well as flue-curing, the tobacco leaves dried on the plant lost more nicotine than the leaves dried separately. The least nicotine was lost in the flue-curing process (90°-160° F.).

From results of other research work, it appears that if, when harvesting, the whole plant is cut for the manufacture of nicotine sulphate, it must be artificially cured as rapidly as possible to prevent the loss of nicotine. The temperature in the curing process should also be considered since some of the nicotine is volatile in steam and disappears with the vapour at a high temperature.

It has been found that in fermentation or sweating of tobacco, almost all the organic substances in the leaves change by being broken up into simpler substances. Nicotine is lost in the same way.

Cultural Methods.

(*a*) *Topping and Suckering.*—Experiments in topping and suckering of tobacco conducted by the Rustenburg Tobacco Research Station during the 1941-42 and 1942-43 seasons, have shown that the nicotine content of tobacco is very much raised and in some cases even doubled, if the flower tops are broken off at the correct stage of ripeness and the suckers regularly removed.

The average percentage of nicotine with topping and suckering was 5·44 while the average for the "non-topping" and "non-suckering treatment" was 2·25 per cent. only. This result is very significant.

These data are supported by considerable research conducted in other countries in respect of the effect of topping and suckering on the nicotine content.

(*b*) *Influence of Spacing on Nicotine Content.*—As a result of the serious shortage of nicotine sulphate in South Africa during the war years, it was considered desirable to establish experimentally how the total yield of nicotine per morgen might be increased, with a view to

possible home production of nicotine sulphate. The favourable influence on the nicotine content of tobacco by such factors as judicious fertilization, topping and suckering of plants and the correct method of curing was known, but research in respect of the production of more nicotine per morgen by the application of other cultural methods was necessary to raise the application of other cultural methods was necessary to raise the profitability of tobacco specifically cultivated for the production of nicotine sulphate.

Subsequently experiments were initiated at the Rustenburg Tobacco Research Station, during the 1943-44 season with the object of studying the possible favourable influence on nicotine production of closer spacing between tobacco plants.

Two tobacco varieties were simultaneously taken for the spacing experiment. A promising selection of *Nicotiana rustica* with a high nicotine content was cultivated in the one experiment, and in order to gain information about the possibility that a heavy snuff type, which has a fairly high nicotine content and gives a high yield per morgen, might produce more nicotine per morgen, the variety *Madole* 73 was used in the other experiment.

As Madole grows to a relatively good height and would suppress Rustica, the two types could not be included in the same composite experiment.

The experiments were conducted on red clay loam alluvial soil under irrigation.

Fertilization per morgen was as follows:—

50 tons compost (air dry).
800 lb. artificial fertilizer mixture A (0:14:6).
100 lb. potassium sulphate.
100 lb. potassium chloride.

In both cases the plants were topped when the first flowers opened and afterwards the suckers were removed regularly.

The tobacco was cut at the correct stage of ripeness and air-cured in a shed with a flat corrugated-iron roof. After the plants had dried, they were conditioned in cellars, weighed, baled and consigned to the Division of Chemical Services for nicotine and moisture determinations.

The yield per morgen is given in Table I.

TABLE I.—*Weight of Air-cured Tobacco (Whole Plant) in lb. per Morgen.*

Spacing.	N. Rustica.					Madole 73.				
	Annual Average.			Average for three years.		Annual Average.			Average for three years.	
	1943/44.	1944/45.	1945/46.	lb.	Per cent.	1943/44.	1944/45.	1945/46.	lb.	Per cent.
6″ × 36″....	4,180	5,750	6,690	5,540	131·3	—	—	—	—	—
12″ × 36″....	3,120	3,590	5,740	4,150	98·4	6,120	11,320	8,010	8,483	114·9
18″ × 36″....	1,720	2,470	4,720	2,970	70·4	5,160	9,620	6,760	7,180	97·2
24″ × 36″....	—	—	—	—	—	4,660	8,280	6,540	6,493	87·9
Average......	3,007	3,937	5,717	4,220	100·0	5,313	9,740	7,103	7,385	100·0
Deviation....	164·5	205·0	101·8	94·0	2·23	179·0	384·0	216·3	158·6	2·1
Signif. dif....	517·0	644·0	322·0	270·3	6·41	562·0	1206·0	679·9	456·0	6·2

With both types the shorter distance between plants in the row brought about a significant increase in the yield per morgen.

Table II reflects the percentage of nicotine on a dry basis as determined by the Division of Chemical Services.

TABLE II.—*Percentage Nicotine* (*whole plant*).

Spacing.	N. Rustica.				Madole 73.			
	Annual. Average.			Av. for 3 years.	Annual Average.			Av. for 3 years.
	1943/44.	1944/45.	1945/46.	Per cent. Nicotine.	1943/44.	1944/45.	1945/46.	Per cent. Nicotine.
6″ × 36″.........	5·65	7·95	3·97	5·86	—	—	—	—
12″ × 36″.........	5·29	9·23	4·56	6·36	3·88	3·04	1·78	2·90
18″ × 36″.........	6·09	8·66	5·02	6·59	3·88	3·32	1·71	2·97
24″ × 36″.........	—	—	—	—	4·21	3·39	1·97	3·19
Average...........	5·68	8·61	4·52	6·27	3·99	3·25	1·82	3·02

Although the narrower spacing in the case of both tobacco varieties exercised no significant influence on the percentage of nicotine, there is nevertheless, generally speaking, an indication that the nicotine content of the plants was reduced by closer spacing of plants.

It is noteworthy that Rustica supplied an average nicotine content of 6·27 per cent. over the three-year period while that of the snuff-species, Madole, was only 3·02 per cent.

The total yield of nicotine in lb. per morgen reckoned on a dry basis, and the percentage of nicotine, are given in the following table.

TABLE III.—*Total Yield of Nicotine in lb. per Morgen on Dry Basis.*

Spacing.	N. Rustica.					Madole 73.				
	Annual Average.			Average for 3 years.		Annual Average.			Average for 3 years.	
	1943/44.	1944/45.	1945/46.	lb.	Per cent.	1943/44.	1944/45.	1945/46.	lb.	Per cent.
6″ × 36″....	203·7	424·5	245·0	291·1	126·0	—	—	—	—	—
12″ × 36″....	143·3	301·6	243·6	229·5	99·4	210·7	301·8	131·6	214·7	110·4
18″ × 36″....	91·6	212·1	251·6	173·1	75·0	178·6	280·7	110·6	190·0	97·7
24″ × 36″....	—	—	—	—	—	172·9	245·5	118·1	178·8	91·9
Average......	146·2	312·7	234·7	231·2	100·0	187·4	276·0	120·1	194·5	100·0
Signif. diff. P·05.......	31·06	72·34	44·69	27·62	12·0	31·68	54·52	94·77	21·3	11·0

Conclusion.

As a result of the increased yield obtained in both cases by closer spacing of the plants, and since the nicotine content of the tobacco was not reliably affected by the closer spacing, the total yield of nicotine per morgen was significantly increased by closer planting. This applies to both types.

The average nicotine yield over the period of three years in the case of Rustica is considerably higher than in the case of Madole 73 in spite of the fact that Madole 73 furnished by far the heavier weight of tobacco per morgen. This is naturally ascribable to the fact that the nicotine content of Rustica is so much higher.

The general conclusion to be drawn from these results is, therefore, that, where in the future tobacco is specifically grown for nicotine production, preference will have to be given to the Rustica type and that the highest production will result from an espacement of 6 inches in the row.

Codling Moth in Pome Fruits:—

[*Continued from page* 518.

D.D.T. must not be mixed with lime or lime sulphur because the lime will decompose it and destroy its killing properties.

In spraying for Codling Moth, as complete a coverage as possible must be obtained, but care should be taken not to put on more D.D.T. than necessary and to avoid run off of the material onto the ground under the trees.

Suggested Spray Programme.

Spray No.	Stage.	Material.	Remarks.
1	Green Tip..............	Lime Sulphur—1 in 20	For Fusicladium.
2	Closed Cluster..........	Lime Sulphur—1 in 80	For Fusicladium.
3	Three-quarter Petal Drop..	D.D.T.—2 lb. per 100 gallons,	Wettable Sulphur or Copper Oxychloride can be added if Fusicladium is bad.
4	14 days later...........	D.D.T.—2 lb. per 100 gallons.	
5	21 days later...........	D.D.T.—2 lb. per 100 gallons.	
6	Summer Spray in December.	Fixed Nicotine—3½ lb. per 100 gallons.	
7	Second generation. Spray in late February.	Fixed Nicotine—3½ lb. per 100 gallons.	

Where D.D.T. has been used in orchards, such pests as Aphids, Mealy Bugs, Woolly Aphid, Red Spider and other mites have sometimes increased in numbers and become troublesome because their natural enemies, such as the Ladybird beetles, have been killed. Such complications must be expected, but there is usually a remedy and in the case of the Codling Moth the use of D.D.T. seems to be worth the risk if a sound crop of fruit can be obtained.

The Balance of Nature in Relation to Insects.

Dr. Bernard Smit, Principal Entomologist, Pretoria.

IT is difficult for us to visualise South Africa as it was before the white man came to this country. Some of us can remember parts that were quite different when we were children from what they are now as recently as forty years ago the mountains around the Cape were covered with thick vegetation and beautiful wild flowers, whereas to-day they are bare slopes of rock and soil.

Before the white man arrived, however, the conditions were still more different. Large natural forests with big stinkwood and yellow-wood trees covered the sides of the mountains, high grass covered the plains and there were no pine, bluegum or wattle plantations which are such a characteristic feature of the landscape to-day. There was no cactus or prickly pear, but far more indigenous bush and far less soil erosion. The vast changes that have taken place through mans' so-called "civilizing influence" have greatly upset the balance of Nature,

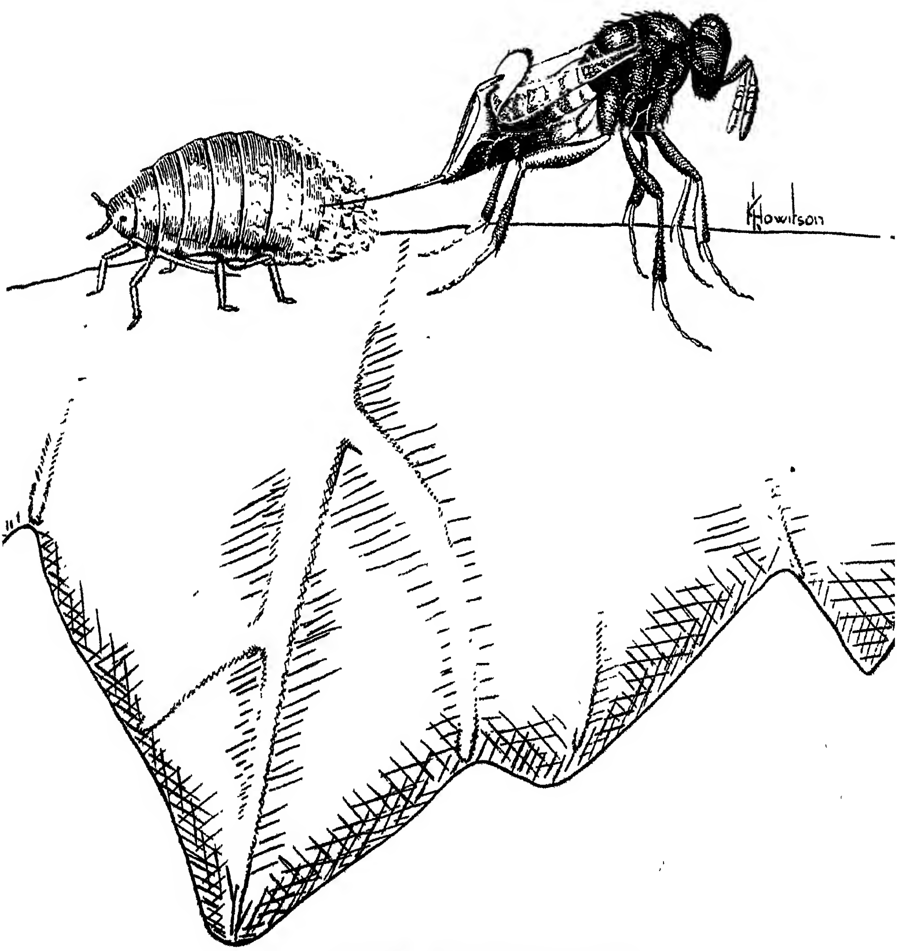

FIG. 1.—*Aphelinus mali* attacking an aphid.

and continue to do so to an ever greater extent. This is particularly the case with regard to the insects.

The chief construction engineer of the Irrigation Department said to me a few weeks ago: "We make new problems for you entomologists to solve". This is perfectly true; but so do the engineers of the Railways, the Roads Department and the officers of the Forestry Department, to say nothing of the thousands of farmers who constantly extend the area of cultivation throughout the country. Overstocking also changes the ecological conditions and upsets the balance, causing insects to become pests as well as causing erosion.

Indigenous and Exotic Insects.

We speak of indigenous plants and indigenous insects. Presumably these have been here for many thousands of years and fit into the natural environment so that a natural balance is maintained. Each plant has a number of insects that live on it, some feeding on the leaves, others on the seeds or flowers, while others bore in the stems. In some cases the insects are very specific, feeding only on one kind of plant, while in other cases they may feed on several kinds belonging to the same group, or in still other cases they may be general feeders and feed on many different kinds of plants belonging to different families. In contradistinction to indigenous plants and insects we have those that have been more or less recently introduced. These we call exotic. In general, indigenous insects in their natural environment are more specific than exotic insects. Also, when man introduces new plants the idigenous insects tend to change their feeding habits and attack the new arrivals. An example of this is seen in our pine plantations in South Africa where several indigenous caterpillars, which normally feed on acacia, have now begun to attack the pines and in the case of the notorious Wattle Bagworm which in Nature also lives on thorn trees. In how far insects can and will change their feeding habits, is a question that is puzzling the minds of the entomologists to no small extent.

The more man changes conditions, the more the insects tend to change. This they are often forced to do, because their natural food plants are removed and they have no alternative but to starve, as may happen in the case where the veld is ploughed up and turned into farmlands. The Harvester Termite and its recent attack on wheat is a good example of this.

Insect Predators and Parasites.

The indigenous insects in turn have their natural enemies in the form of insect predators and parasites which prey upon them. The difference between a predacious insect and a true parasite is often difficult to define. By a predator we mean an insect which devours its host from the outside, rather like a lion devours a buck, but usually without killing it beforehand. Ladybird beetles devour aphids, and Tiger beetles hunt and feed on other insects in this way. We also speak of predacious wasps, which first sting their victims to paralise them and then carry them to their nests where their larvae feed on them, also from the outside, but usually by sucking out their body juices. In the case of the Blow-fly pupal parasite *Mormoniella*, the small Chalcid wasp lays her eggs inside the pupal capsule of the fly, but on the outside of the actual pupa, so that when these eggs hatch the parasite larvae, which are very small grubs, lie between the fly pupa and its puparium and feed by sucking the body juices of the fly pupa. In this case we think of *Mormoniella* as a true parasite, although it might almost be called a

predator in its larval stage. A typical parasite is *Aphelinus mali*, the small Chalcid which attacks the Woolly Apple Aphid. This wasp lays its eggs right inside the bodies of the aphids where they hatch and where the larvae develop and pupate. The adult parasite emerges later from the dried-up body of the aphid through a circular hole cut in its back.

The true parasites are far more numerous and active than most people realise and they are represented amongst many groups of insects. There are literally thousands of species which attack their hosts at all stages of development and under a vast variety of circumstances. Each has different habits, and while some are very specific and will only attack one species of insect host, others will attack a wide range of hosts and thus have many alternate hosts. Where we are trying to control pest insects with parasites, it is often an advantage to have a parasite that is not too specific, because after it has destroyed one pest it can then survive until the next season by feeding on another.

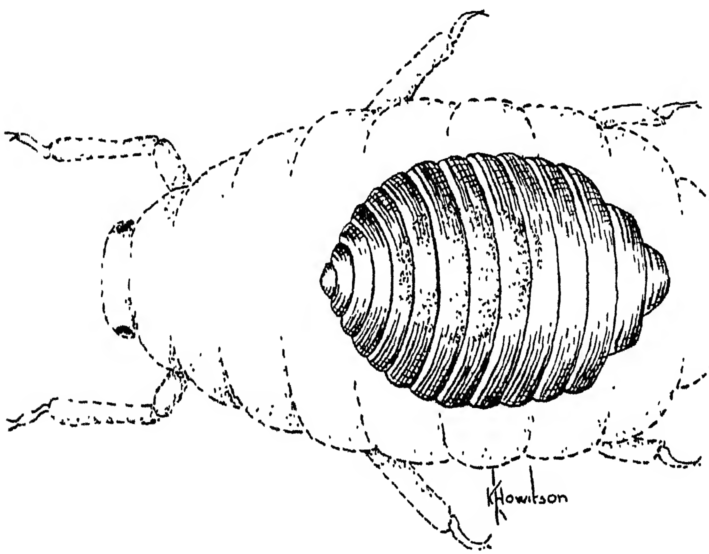

FIG. 2.—Full-grown larva in the body of an aphid.

Where a plant-feeding insect has a number of predators and parasites that attack it, we find that competition often develops between these natural enemies, and the problem of their inter-relationship becomes very complicated. Each parasite may be effected differently by its ecological environment and become more or less adapted so as to ensure its own survival. An example of this was discovered by Dr. Ullyett, Head of the Union Government's Sunnyside Parasite Laboratory. The Bollworm, *Chloridea obsoleta*, in the eastern Transvaal, which is a pest on several kinds of vegetables, is attacked by two species of Hymenopterous egg parasites, *Trichogramma* and *Telenomus*. The temperature conditions are favourable for both these parasites throughout the year, but during the winter *Trichogramma* is very scarce because of low atmospheric humidity. When summer rains come and the air becomes damp, this parasite thrives and helps greatly to control the Bollworm. *Telenomus*, on the other hand, likes dry conditions and becomes more abundant in the winter. Direct competition between these two parasites is therefore avoided. In some cases there are as many

as forty or fifty competing species of parasites, and it can be well imagined how many different factors there are in operation in such a case.

Secondary Parasites.

In addition to all this, many parasites have hyper-parasites called secondary parasites, which in turn attack them. These are usually small Hymenoptera which lay their eggs in the bodies of the larvae of the primary parasites. There may be several of these competing against each other, and their inter-relations are even more difficult to study than those of the primaries. Actually there are cases where the hyper-parasites are attacked in their turn by a third group called tertiaries, but for the purpose of this article, this phase of the matter needs no further discussion. If the first insect feeding on the plant is a pest, then the primary parasite is a beneficial insect, the secondary parasite is a harmful insect, the tertiary is beneficial, and so on. If, however, the plant in the first instance is a pest or weed, the whole position is reversed. This is well illustrated in the case of the eradication of prickly pear. The prickly pear was a pest and the Cochineal insect was introduced as a beneficial insect to destroy it. At the same time spineless cactus, which is just another variety of the pear, was being grown as a stock feed. When the cochineal went over to attack the spineless

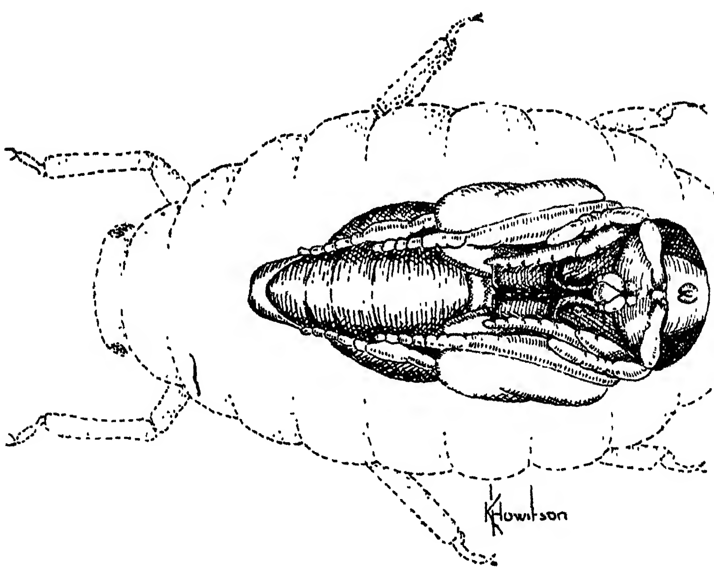

FIG. 3.—Pupa of A. *mali* in a dead aphid.

cactus, it became a pest. Years before, the Cryptolaemus Ladybird beetle had been introduced to control the Citrus Mealybug and when the Cochineal insect was introduced, the Cryptolaemus beetle began to feed on it. It should be noted that the Cochineal is closely related to the Mealybug. On the prickly pear the Ladybird beetle, therefore, became a pest, while on the spineless cactus it is considered a beneficial insect. Incidently, the Cryptolaemus beetle has become so abundant, through having an abundance of Cochineal to feed on, that it has almost completely wiped out the Mealybug on the citrus trees, except where D.D.T. has been used in the citrus orchards.

Limiting Factors.

We must keep in mind that the most important factor limiting the increase of any insect, or, for that matter, of any animal, including human beings, is the food supply. As a parasite attacks its host it automatically reduces its supply of food, and its rate of reproduction slows down accordingly. The food may become so scarce that the parasite dies out altogether, but usually a few manage to survive until the host begins to breed up again. Thus we usually find that biological control of plants or insect pests runs in cycles or waves of abundance, followed by periods of scarcity. The pest is never quite eradicated and at certain periods becomes destructive, but the parasite also persists and brings the pest under control at intervals. At the same time the weather and the seasons exert their influence and this also tends to cause the pest to fluctuate in intensity in more or less regular waves. As an instance of this we may again refer to the Citrus Mealybug and its Ladybird beetle predators. In the winter all insect activity is retarded and both Mealybugs and beetles are very scarce. In the spring the Mealybug begins to multiply very quickly, as it has plenty of food from the developing oranges. By about the middle of the summer it is abundant and beginning to damage the fruit. Then the numbers of Ladybird beetles increase

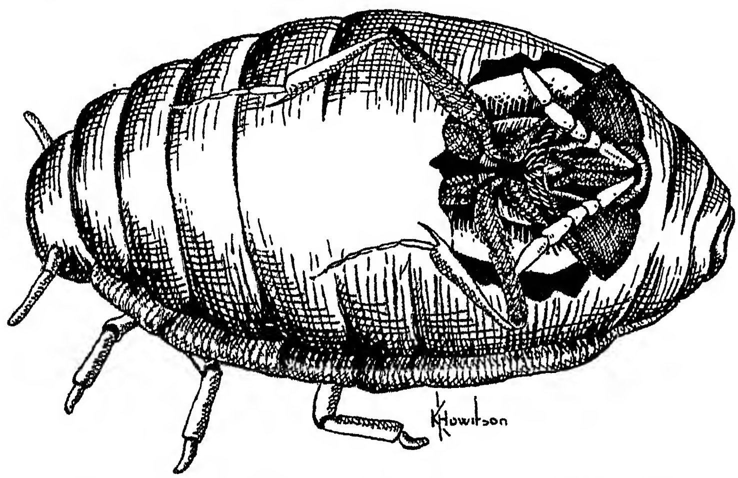

FIG. 4.—A dult A. *mali* working its way out of a dead aphid.

rapidly and the predator begins to cath up with its host. During the autumn the beetles clean up the Mealybug, and the farmer gets a clean crop of fruit, while the beetles spread everywhere in search of food. Enormous numbers of them starve and very few survive to pass the winter. There are always a few, however, both of the Mealybugs and the Ladybird beetles that do live through the winter to start the cycle again the next spring.

Apart from upsetting the balance of Nature by introducing exotic plants, man introduces exotic insects, usually by accident and without knowing it at the time of introduction. This is because the insects are small and come in as stow-aways in ships, trains, motorcars and aeroplanes. Usually their presence in the country is not noticed for several years until they have become well-established and begin to cause damage as pests. In the cases of the *Hylotrupes* woodboring beetle and the Drywood Termite, the insects had been in South Africa fifteen or twenty years before they were discovered and the destruction they cause began to assume serious proportions. Some insects, like the Codling Moth and the Mediterranean Fruit Fly, have probably been in the Cape since

the first apples and stone fruits were brought in. Considering the pest insects, therefore, we have two distinct groups, (1) the indigenous insects, and (2) the exotic or introduced insects. Both these groups may attack either the natural vegetation or our introduced plants.

Two Distinct Groups of Pest Insects.

In the first group the Karroo caterpillar destroys the natural Karroo bush *Pentzia,* causing enormous losses in the sheep areas of our country, while the native Christmas caterpillar, *Nudauretia,* attacks the introduced pine trees. In the second group the exotic Bollworm, *Chloridea,* attacks our native kaffir corn, and the introduced Codling Moth is the worst pest of our introduced pome fruits.

The worst of our insect pests are those that attack our introduced plants, and the more important the crop, the greater damage they do. The greatest damage occurs in a case where a plant is first introduced without its natural insect enemies and finds conditions favourable to its growth. It grows luxuriantly for a number of years and is propagated by

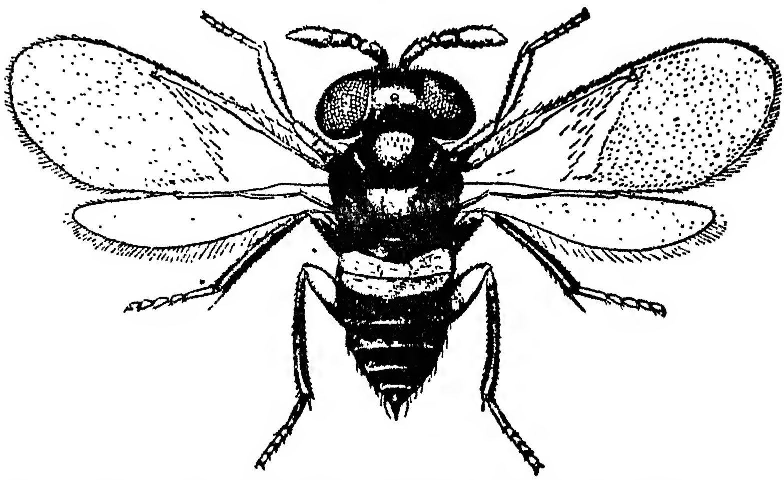

FIG. 5.—Adult A. *mali.* Note the characteristic light-coloured anterior portion of the abdomen.

man on a large scale. When the insect comes into the country it finds an abundant food supply and breeds up enormously, sometimes almost wiping out the cultivated plant. This is what happened in the case of the Eucalyptus Snout beetle twenty-five years ago, and the same thing could happen any day now to our South African pine plantations.

In the case of the Eucalyptus Snout beetle, Mr. Tooke, the Forest Entomologist, was sent to Australia, the natural home of the eucalyptus trees and also of the Snout beetle, and there he found a parasite of the beetle which kept it in check. The minute parasite was introduced into South Africa and very soon it began to establish a balance here. After ten years it had saved our bluegum plantations in most parts of the country, and now the Snout beetle has virtually ceased to be a pest. It is estimated that this one parasite has saved the bluegum plantations of South Africa which are worth about three million pounds. Almost the same excellent results were obtained by Dr. Lundie when he introduced *Aphelinus mali* from America to control the Woolly Apple Aphis in 1920. You will notice that in these cases the entomologists searched for the beneficial parasites in their native countries from which the pests also came. This is the usual procedure. Great care is also taken not to introduce any secondary parasites which might upset the balance in the other direction.

Where an idigenous insect attacks a crop it usually has its own indigenous parasites living upon it, but if it is a pest, these are obviously not effective in keeping it under control. What can we do then? Sometimes there is a pest insect in another country which is closely related to our own pest and which has parasites in that country keeping it under control. If we introduce one or more of these, they may attack our own pest with beneficial results. This is well illustrated in the case of the Karoo caterpillar. It has become a pest because of our methods of sheep farming, and its natural enemies cannot keep it in check. In America there is a similar caterpillar belonging to the same genus *Loxostege* and there it has a parasite called *Chelonus taxanus*. This has now been introduced into South Africa where it has begun to attack our Karoo caterpillar. There are also other similar parasites that are being introduced.

As we have said, some parasites are very specific while some attack a wider range of hosts. They must not go too far in this respect, else they may attack beneficial insects as well as pests. These Hymenopterous wasps are not likely to do that, however, because on the whole they are very fixed in their habits.

Mode of Parasitic Attack.

Each parasite attacks its host at some particular stage in its development. The parasite of the Eucalyptus Snout beetle is a true egg parasite. It develops entirely in the egg of the host and, as we should expect, is therefore, extremely small. In the case of the Chelonus, the female lays her egg in the egg of the Karoo caterpillar, but this still hatches normally into a caterpillar which feeds and grows until it is almost ready to pupate. The parasite is developing inside the caterpillar all the time, however, and finally an adult Chelonus wasp emerges instead of the Karoo moth. In the case of *Meteorus loxostegei*, another Karoo caterpillar parasite, the female lays her egg in the body of the caterpillar, while *Cryptus inornatus* is a pupal parasite and attacks only the pupae. The adult of this parasite emerges from the moth pupae.

Although we try to keep pest insects out of the country, the time will eventually come when all insects have spread throughout the world and become established wherever conditions are suitable for them. This may take many hundreds or thousands of years, but the more travel and inter-change of goods there is between the different countries, the sooner this time will arrive. The aeroplane is likely to speed up the spread of pests throughout the world very considerably. This makes more work for the entomologist in introducing beneficial parasites, but in carrying out this work of biological control, no parasite should be introduced before it has first been thoroughly studied in its native land to make sure that it is a primary parasite and that it will not do more harm than good when it arrives in its new home. The object of this article is to give some idea of the complexity of the problem and the amount of work involved in studying it.

Short Course in Beekeeping.

A Short Course in Beekeeping will be held at the Potchefstroom College of Agriculture, from the 1st to the 5th November, 1948.

Hostel accommodation is not available, and students are expected to make their own arrangements in this respect. The fee is 5s. payable on booking. Railway concession certificates are issued. Application forms and any further information required may be obtained from the Principal.

The Feeding of Poultry During the War.

P. J. Serfontein, Professional Officer, (Poultry Research), College of Agriculture, Potchefstroom.

THE immediate problem with which the poultry breeder was faced as a result of the war, was how to change his rations in such a way as to ensure sufficient proteins, vitamins A and D, riboflavin and the associated water-soluble factors. This step became necessary as a result of the partial or complete disappearance off the market of certain nutrients which had been in common use, such as pollard, wheaten bran, etc.

Without the scientific knowledge in respect of feed now available, it would in those circumstances, have been impossible for the Poultry Industry to expand sufficiently to meet the increased demand for poultry products during the past seven years.

Some thirty or thirty-five years ago poultry-feeding was an art rather than a science. Simple feed mixtures were used, the most important constituents of which were wheat and wheaten by-products. The average egg production was not half that of to-day. There were no commercial mixtures on the market.

War conditions during the first world war (1914-18) led to research in the sphere of poultry nutrition. Wheat prices soared above those of maize, and consequently the latter was fed to poultry. It was during this period that meat meal came to be generally included in the poultry rations. And so the poultry-feed industry was started. It was during this period, too, that the foundation of our knowledge of the vitamins was laid.

In the following six years two important developments took place in the sphere of poultry nutrition. It was found that yellow mealies were an important source of vitamin A, and cod-liver oil was added to the poultry mixtures. Afterwards fortified cod-liver oil and sardine oil came on the market and later still, various mixtures of oil became available.

It was after 1920 that the value of milk products in poultry nutrition aroused attention, and later the value of fish meal and lucerne meal was proclaimed.

Between 1930 and 1940 various important discoveries were made in connection with feed. New nutrients were developed and existing ones improved. The importance of manganese in poultry feed was established. It was proved that it prevents the development of perosis and encourages hatchability as well as the formation of strong egg shells. Research has brought to light the fact that heating enhances the nutritive value of soybean meal, in some cases actually increasing the biological value by 50 per cent. Improved methods have been applied for the drying of lucerne with a view to the preservation of the carotin content. The importance of riboflavin in poultry feed has been proved, and new fermentative by-products have been developed to supply this factor. During this period also, appropriate methods of preparation of "D"-treated animal sterol were devised.

All this new knowledge is utilized in the composition of poultry rations, and hence, meat meal, fish meal, cod-liver oil, powdered milk, lucerne meal, wheaten bran, pollard, yellow mealiemeal, liver meal, soybean meal, groundnut oil-cake meal, molasses, manganese sulphate and

fermentative by-products are now generally used in the composition of poultry rations. We are dependent upon these constituents for the composition of balanced rations.

On the outbreak of war in 1939 the following standard requirement was set for a balanced ration.

TABEL I.—*Protein, Vitamins and Mineral Requirements for Poultry.*

Constituents.	Per pound Food.			
	Chicks.	Laying hens.	Poults.	Breeding turkeys.
Protein %..........................	19·5	16	22—25	16·5—17
Crude fibre..........................	3·5—5	3·5—5	3·5—5	3·5—5
Vitamin A (I.U.)....................	1200—1800	3300	2500	4000
Vitamin D3..... (A.O.A.C. Units).:..	180	450	260	450
Vitamin E (Alfa Tocopherol m.g.)......	1·4	1·4	1·4	1·4
Vitamin K (Antihemorrhage vitamin)..	0·2—0·5	1·0	0·2—0·5	1·0
Thiamine (Vitamin B1 m.g. Anti beri-beri, Anti neuritic Aucurin).........·	0·9	?	?	?
Riboflavin (Vitamin G.) Vitamin B_2 m.g. Lacto-flavin hepatoflavin ovaflavin...	1·6—0·9	0·9—1·3	2·0	1·8
Niacine (Nicotinic-acid). Nicotinic-acid amide Pellagra-preventive factor............................	8·0	?	?	?
Pantothenic acid (Antidermatitis factor) m.g..............................	5·0	7·0	—	—
Pyridoxine (Vitamin D6) m.g..........	1·6	1·6	?	?
Biotin (Vitamin H) m.g................	0·045	0·07	—	—
Vitamin C..........................		No Requirements.		
Choline (Choline chloride) m.g.........	0·7	?	0·9	?
Calcium %..........................	1·0	2·25	1·6	2·25
Phosphorus %........................	0·6	0·75	1·0	0·75
Sodium chloride %..................	0·5	0·5	0·5	0·5
Manganese m.g.s.....................	25	15	25	15
Iodine m.g..........................	0·5	0·5	?	?

Any ration, therefore, that does not conform to the standard requirements as given in Table I, will lead to a deficiency in some nutrient or other. This nutrient deficiency is set out in Table II.

TABLE II.—SYMPTOMS OF DEFICIENCY IN THE DIFFERENT VITAMINS.

Vitamin.	Symptoms of deficiency.	SOURCE.	
		Nutrients.	Concentrated form.
Vitamin A.......	Suspectibility to deseases of respiratory organs. Disturbs reproduction. Reduces egg production. Causes roup. Deposits urate crystals in the Kidneys. Serious deficiency causes Xerophtalmia and even death.	Yellow mealies, gluten meal, liver meal, green feed, lucerne meal, lucerne leafmeal.	Fish oil, Sharks-liver oil are very rich in this element. Fortified oils, Root-oil or carotin dissolved in oil are good sources of vegetable origin.

Table II.—Symptoms of Deficiency in the Different Vitamins.—Continued.

Vitamin.	Symptoms of deficiency.	Source.	
		Nutrients.	Concentrated form.
Vitamin D..	Chicks and poults develop rickets. In adult fowls egg production is reduced, weak egg-shells caused and hatchability reduced. Full-grown fowls finally go lame.	Some of the fish meals contain small quantities of vitamin D. Sundried lucerne meal will supply vitamin D for other animals but not for fowls.	Cod-liver oil. Certain oils of assured vitamin A and D content. Treated animal sterol for poultry.
Vitamin E.......	Essential for chicks, otherwise they die in the embryo 3 or 4 days after setting to hatch. Muscle building is another symptom and possibly encephalomlacia.	All cereals, lucerne meal, vegetable oils, green feed, Vitamin E is present in feed products containing the cereal germ.	Maize germ oil, mealie oil, soybean oil, lucerne leaf meal. The pure chemical D1-Alfatocopherol accetate is the richest known source
Vitamin K.......	Causes delay in Clotting of blood in chicks, poults and ducklings. The slightest scratch bleeds continuously.	Green feed, pig liver and lucerne meal are good sources. Vegetable oil such as soybeanoils, have in a measure anti-hemorrhagic value. This, too, is the case in some species of fish meal.	An artificial Vitamin K mixture Methyl and 4 naphthoquinones is the richest known source.
Thiamine.........	Chicks and other poultry lose their appetites, and develop lameness in leg and wing muscles, head retraction and eventual death.	All unheated cereals. Cereals which contain the germ are specially rich in this vitamin. Linseed, cotton seed, groundnut and soybean meal are excellent sources. Dried milk is a good source, but fish meal and meat meal are not always good.	Brewers' yeast is an excellent source of Thiamine. Liver meal, pure crystallised Thiamine-hydrochloride is available and is the most concentrated form.
Riboflavin.......	Typical symptoms are turned-in toes, lameness as well as slow growth. Low hatchability. Egg production falls. Turkeys also exibit encrusted corners of the beak and other forms of dermatitis.	Milk and dairy products are good sources. Lucerne and lucerne leaf-meal are very good. Meat meal and fish meal are also good sources. All food matter of grain or oil derived from cereal, sources contain a little riboflavin.	Fermentation Solubles, especially of butyl alcohol production, are potent sources of riboflavin. Dried solubles from commercial alcohol production are a rich source. Liver meal and brewers' yeast are concentrated sources. Pure synthetic riboflavin is available and is a pure vitamin.

Table II.—Symtoms of Deficiency in the Different Vitamins.—(Continued.)

Vitamin.	Symptoms of deficiency.	Source.	
		Nutrients.	Concentrated form.
Niacin..........	When niacin is absent, chicks develop chicken blue tongue. This is an inflamation of the tongue and mouth cavity. Poor feather growth and sometimes Scabby dermatitis of the feet.	Wheaten bran, pollard groundnut meal. Meat products are possible good sources. Soybean oil cake meal is a reasonably good source. Dairy products contain appreciable quantities but not outstanding amounts.	Dried beef or pork liver. Dried yeast and wheaten bran are concentrated sources. Pure nicotinic-acid is also available.
Pyridoxine.......	Slow growth in chicks. Reduced food consumption. Abnormal nervousness. Loss of appetite in grown fowls. Loss of weight, egg production and hatchability.	Molasses, dairy products, meat and fish meal, lucerne meal, groundnut and soybean meal.	Brewers' yeast. Liver meal. Rice bran Synthetic pyridoxine, hydrochloride.
Pantothenic acid..	Chicks develop dermatitis which includes ulcers in the corners of the mandibles, granular eyelids and spinalcord lesions.	Dried dairy products, groundnut meal. Sugarcane molasses, lucerne meal and yeast are good sources. It is also present in small quantities in cereals.	Brewers' yeast. Liver meal. Fermentation residues, synthetic calcium pantothenate.
Biotin...........	A biotin deficiency causes a dermatitis very similar to that resulting from a deficiency of pantothenic acid. The pads under the feet become scabby and cracks appear with signs of bleeding. The eyes sometimes close and the corners of the mandibles become hard. In the case of pantothenic acid this symptom is first noticed in the mouth and the feet are seldom affected. Biotin prevents perosis in poultry.	Soybean meal, cereals, molasses, milk, lucerne, green grass and yeast.	Liver and Kidneys.
Choline.........	A deficiency causes slow growth. Feed consumption is reduced. Perosis develops in spite of sufficient manganese and/or biotin. Deficiency believed to cause fatty livers in laying hens.	Meat meal, dried milk, groundnut meal, wheaten bran, pollard, wheaten germ meal, liver meal, fish meal.	

TABLE III.—*Some of the Constituents of our Best Known Poultry Feed.*

Feed.	Protein.	Crude Fibre.	Calcium.	Phosphorus.	Manganese.	Vitamin A.	Vitamin D.	Riboflavin.	Pantothenic acid.	Thiamine.
	Per cent.	Per cent.	Per cent.	Per cent.	d.P.M.	p. lb.	p. lb.	Mg. p. lb.	p. lb.	p. lb.
Buckwheat	10	—	0·06	0·43	80	—	—	300	—	—
Barley	11·8	5·9	0·05	0·36	16	400 I.U.	Trace.	400	0·7 U.	250 I.U.
Oats	11·2	11·3	0·10	0·36	34	80 I.U.	—	400	0·7 U.	500 I.U.
Cowpeas	23·5	4·1	0·10	0·46	30	1,360 I.U.	—	350	1·3 U.	450 I.U.
Kaffircorn	11·5	2·0	0·03	0·35	16	250 I.U.	—	—	—	—
Wheat germmeal	28·9	2·7	0·07	1·01	160	1,900 I.U.	—	1,800	0·5 U.	1,930 I.U.
Wheaten bran	15·6	9·0	0·11	1·21	119	150 I.U.	—	1,000	1·8 U.	450 I.U.
Pollard (wheaten)	17·6	5·5	0·08	0·93	60	120 I.U.	—	900	0·8 U.	1,00 I.U.
Mealies, (white)	9·3	2·1	0·01	0·29	5	—	—	450	0·7 U.	270 I.U.
Mealies, yellow	9·3	2·1	0·01	0·29	5	3,180 I.U.	—	450	0·7 U.	270 I.U.
Mealiemeal	43·0	2·6	0·06	0·40	4	6,800 I.U.	—	—	—	—
Rice Bran	13·0	12·5	0·10	1·84	280	—	—	900	1·8 U.	1,500 I.U.
Rye	11·5	2·1	0·05	0·36	40	—	—	—	—	250 I.U.
Brewer's yeast	46·5	1·1	1·26	1·21	2	—	—	16,000	—	4,500 I.U.
Groundnut meal	45·7	9·2	0·18	0·56	—	250 I.U.	—	1,200	4·0 U.	900 I.U.
Cod-liver oil	—	—	—	—	—	340,190 I.U.	45,360 U.	—	—	—
Liver meal	65·4	0·8	0·11	0·90	4	?	?	185,000	8·0 U.	?
Milk powder	35·0	—	1·27	0·96	0·6	130 I.U.	—	9,000	2·5 U.	400 I.U.
Soybean meal	43·9	5·9	0·29	0·69	30	170	—	1,400	1·0 U.	900 I.U.
Meat meal	55·2	2·2	8·25	4·00	18	?	?	2,700	0·2 U.	?
Fish meal (white)	61·6	0·4	9·09	4·70	—	?	?	4,500	0·2 U.	?
Fish meal (sardine)	67·0	0·4	4·73	2·63	40	?	?	3,200	0·2 U.	?
Molasses (cane)	3·0	0·0	0·56	0·06	—	?	?	2,000	6·0 U.	?
Lucerne (green)	4·6	7·5	0·42	0·07	7	63,560	—	2,000	0·1 U.	225 U.
Lucerne meal (Artificially dried)	16·0	27·3	1·44	0·21	26	95,000 U.	—	8,000	3·0	450 U.
Lucerne meal (Suncured)	16·0	27·3	1·44	0·21	26	13,000 U.	—	5,000	1·5	400 U.
Lucerne leaf meal	20·4	17·1	1·90	0·22	30	32,000 U.	—	7,000	2·0	400 U.

Table II shows the symptoms of the known feed deficiencies in poultry, as well as the sources from which these deficiencies may be supplemented. In order to give a better idea of how we were effected by these deficiencies, some of the constituents of our best-known poultry feeds are given in Table III.

Table I gives the standard requirements for poultry, Table II, the feed deficiencies, and Table III, the constituents of the available foods. With these data at our disposal we can trace the trend of development from 1939 to 1947.

At the outbreak of war in 1939 all poultry rations contained large quantities of wheaten products, such as wheaten bran, or wheaten bran meal, better known as pollard. Much of the pollard consisted of wheat-germ meal. Typical pre-war rations are given in Table IV.

TABLE IV.—*Pre-war and War Rations.*

	LAYING RATIONS.		CHICK RATIONS.	
	Pre-war.	War.	Pre-war.	War.
	lb.	lb.	lb.	lb.
Pollard (wheaten bran meal)	37·5	—	35·0	—
Wheaten bran	20·0	—	20·0	—
Yellow mealiemeal	10·0	36·0	15·0	44
Maize-germ meal	—	10·0	—	10
Oatmeal	10·0	20·0	10·5	10
Lucerne meal	10·0	10·0	7·5	10
Groundnut oil-cake meal	—	5·0	—	5
Meat meal	10·0	12·0	10·0	14
Bone meal	2·5	2·0	1·0	1
Oyster shell powder	—	3·0	1·0	3
Molasses	—	2·0	—	3
Salt	—	½	½	½
Cereals:				
Yellow mealies	50	100	—	—
Wheat	50	—	—	—

The large percentage of wheaten products used in our pre-war rations, is strikingly illustrated by the data in Table IV. The wheat shortage necessitated the provision of a substitute for these products. The nutrients available for this purpose were yellow mealie meal, oatmeal and lucerne meal. From Table II it will be seen that, with the disappearance of these products, manganese, riboflavin, pantothenic acid, and thiamine were considerably reduced, since these constituents are not as well represented in the substitutes, mealies and oats, as in wheaten by-products.

Not only had wheat and its by-products become unprocurable, but other nutrients, such as cod-liver oil, meat meal, fish meal, bone meal and groundnut-cake meal were also very difficult to obtain. The climax in the series of deficiencies was reached when yellow mealies had to a large extent to be replaced by white mealies.. The vitamin A content of poultry was so reduced that there were several cases of roup; the hatchability suffered and the chicks made poor growth. There was a general increase on the incidence of coccidiosis and worm infestation, since a lack of vitamin A reduces resistance in fowls.

As a result of the shortages, all the deficiency defects, described in Table II, made their appearance at some time or another. I myself, am of the opinion that the shortages cannot be held entirely responsible for these difficulties. The registration of Stock Feed, as published in the

Government Gazette of 24 July, 1942, was also partly responsible. According to this regulation chick mixtures had to contain a minimum of 19 per cent. protein, and laying mixtures, 20 per cent. This regulation provides exclusively for the protein and fibre content of poultry rations. These shortages became common when rations with a higher protein content were fed. The higher the protein content of a ration, the more rapid the growth of the chicks and the greater the demand for the different vitamins. Before 1939 the protein content of poultry rations was, generally, much lower that that laid down in the regulation quoted above. No provision was, however, made for the other standard requirements as stated in Table I. As a result of the higher protein requirements and the absence of or deficiency in the vitamins, nutrient deficiencies have cost the poultry industry thousands of pounds.

Another noticeable change in the sphere of poultry feeding is the increased consumption of commercial rations. Before the outbreak of war in 1939 most poultry farmers mixed their own rations. Although the following figures include all balanced nutrients, they nevertheless also represent the proportional increase in the consumption of commercial rations by poultry. The consumption of balanced feeds in 1939 amounted to approximately 12,000 tons and represented a value of something like £10,000, while in 1946 it had increased to about 30,000 tons with a corresponding value of more or less £3,500,000. A consideration of these figures clearly shows the magnitude of the industry—an industry still in its infancy in so far as scientific development is concerned. This sphere is still entirely virgin field.

The war years have furnished interesting data.

Undoubtedly, no other individual feed has gained more popularity during the last few years than lucerne meal. There must be a reason for this. Lucerne meal had always been regarded as a good feed; it was only during the war that its value was fully appreciated. For some years past it has been known to be a good and cheap source of Vitamin A. Apart from this, its other nutritive factors were virtually unknown. Initially, poultry feeders did not welcome the inclusion of a high percentage of lucerne meal in rations in the least.

The only source of vegetable pigments available in commercial quantities were lucerne meal and yellow mealies, since it contains green pigments, absent in mealies, and is usually a very much richer source of yellow pigments. Unfortunately, as is well-known, the pigment content of lucerne and dried lucerne is changeable depending upon such factors as soil, climate, stage of growth and cutting, method of drying and conditions of conservation. From Table V an idea may be gained of the yellow pigment content of fresh lucerne, a good sun-dried lucerne meal and an artificially dried lucerne meal. The chlorophyll content is not given because sufficiently reliable information about this element is lacking. It is, however, usually a few times as much as the other pigments together. Possibly five times as much as in fresh lucerne, and up to as much as 20 to 30 times the quantity in the dried product, since green pigments are not as readily destroyed in drying as the yellow pigments. The quantity of the newly discovered follic acid has also not yet been definitely determined, but most likely is not higher than three parts per million in sun-dried, and ten parts per million in artificially dried lucerne meal. Very much higher quantities may be present in fresh lucerne.

Of the pigments, chlorophyll is present in the greatest quantity in lucerne. This pigment, as fas as is known, has no special function in the growth of poultry. It is, however, this element in lucerne meal which

makes the product so attractive for inclusion in rations. It gives the mixture a good colour though this element does not exactly add to the nutritive value of the mixture.

TABLE V.—*Pigment and Vitimin Content of Lucerne.*

Pigments.	Parts per One Million of dry Material.		
	Freshly cut.	Artificially dried.	Sun dried.
Chlorophyll	?	?	?
Caratin	450	200	30
Xanthophyll	500	270	50
Riboflavin	35	15	12
Follic acid	?	10	3
TOTAL	985	495	95
Colourless Vitamins:			
Alfa tocopherol (Vit. E.)	152	104	26
Nicotinic acid (Niacin)	132	50	40
Pantothenic acid	90	40	26
Thiamine	13	5	3
Pyridoxine (B_6)	?	?	?

According to Table V, lucerne meal contains, next to chlorophyll, the yellow Xanthophyll in large quantities. As far as is known they too have no special function in poultry feed. They are not essential to life and health. They are, however, responsible for the yellow in the egg, the feet and body fat of the fowl. The colour of these parts can be regulated from a colourless yellow to a deep yellow, depending upon the Xanthophyll content of the ration. The yellow pigment is absorbed by the digestive organs and conveyed through the bloodstream to all parts of the body to be deposited without undergoing any change in the parts of the body concerned.

The third pigment in the list is beta-carotin, a reddish-yellow element which, more or less, serves as a source of vitamin A in certain animals. It differs from Chlorophyll and Xanthophyll in that it has a definite nutritive function. It is probably not utilized as such in the body, but has first to be converted into colourless vitamin A, as is noticed in the case of cod-liver oil. Animals differ considerably in their capacity for effecting the change and so utilizing the carotin. Rats make the most effective use of it, and then fowls, pigs, bovines and horses.

The fourth pigment present in lucernc is riboflavin which is also yellow. This element is esential for fowls. Chick rations should contain larger quantities than rations for grown fowls. The older the fowl becomes, the lower are the requirements, possibly as a result of the production of a certain amount of pigment in the alimentary canal. Larger quantities are required for the production of breeding eggs than for other eggs. For producing breeding eggs the hen should have the opportunity of conserving sufficient flavin in the egg for developing the embryo. Lucerne meal is, however, not such an economic source of this pigment as some of the fermentative by-products. Nevertheless lucerne meal in poultry feed is an important source of riboflavin, since, if lucerne meal is used in quantities to supply the other pigments, a fair quantity of riboflavin is supplied.

The fifth pigment present in lucerne meal is follic acid, also yellow. It is an essential element for all animals. Certain bacteria need it for growth, especially lactic-acid bacteria found in milk. It may also be of importance in the development of useful bacteria in the alimentary canal of animals.

According to Table V artificially dried lucerne meal contains five times as much pigment as the sun-dried product. Our interest in lucerne meal is chiefly as a source of pigments. During the drying process artificially dried lucerne loses 50 per cent. of the carotin and sun-dried lucerne 90 per cent. These losses together with the loss during the conservation period, endangers the utilisation of lucerne meal in the future. More stable products may be found. During the last few years cod-liver oil, for example, has been replaced by cholesterols and ergosterols in rations as sources of Vitamin D. Dried milk powder as a source of riboflavin is replaced by butenol fermentative products. Thus, there is every possibility that more stable products will be found for fulfilling the requirements of carotin, Xanthophyll, etc, that these may replace lucerne meal in the future. In conclusion, it may be added that the determination of the value of lucerne meal on a basis of protein fat and fibre no longer receives much attention.

Before the war we heard a great deal about the pro-vitamin A value of yellow mealies. We know that mealies have a high carotin content which is converted into Vitamin A in the body of the fowl. Poultry do not effectively utilize carotin. The general opinion current is that it is a mistake to depend on mealies and other carotin containing material for Vitamin A in the ration. It is said that a large percentage of the Vitamin A in poultry rations should consist of Vitamin A derived from fish oil, etc.

Before the war, cod-liver oil was regarded as a very rich source of Vitamin A and D for poultry. As a result of war conditions, the Norwegian cod-liver oil was exported to Germany and the balance to England. Cod-liver oil virtually disappeared from the market. Various shark and other fortified Vitamin A and D oils appeared on the market and to-day no importance is attached to the origin of the Vitamin A and D oil but merely to the guaranteed strength. Vitamin A and D oil have supplanted cod-liver oil, and these vitamins are procurable to-day in powdered form.

It is known how readily Vitamin A may be destroyed. Not only does this vitamin lose its physiological strength in elements before it is passed into food, but the loss takes place after it has been sold to the consumer. The result is that the final product contains much less Vitamin A than is estimated according to the values given in text-books. Although Vitamin D is more stable in poultry feed than Vitamin A, it has been proved that a large percentage of this vitamin is lost after the food has been stored for a long time.

Another problem that has arisen as a result of the war is the provision of sufficient quantities of high quality protein for poultry-feed mixtures. This country depends chiefly on foreign countries for its proteins. Many of these cources were no longer available. Other countries, such as the U.S.A. were in the fortunate position that large quantities of soybeam oil-cake meal became available for use in poultry rations. More importance was attached to the amino-acid composition of soybean meal. Large quantities of animal proteins may be replaced by soybean meal. Other vegetable proteins could not be utilized so effectively. The best results were obtained when sea-products were fed to poultry in conjunction with soybean meal. Fish meal contains factors for growth not replaceable by methonin, choline, or the known vitamins, when it is used for supplementing soybean meal rations. In this connection we are faced with interesting complications. Groundnuts are produced in the country on a large scale, and this production is to be

increased. Large quantities of groundnut oil-cake will become available. With the aid of chemists this source of proteins may perhaps yet replace the major portion of the proteins in poultry rations. With the present data at our disposal, the use of this protein is still limited.

It has been found that fermentative by-products of both ethyl and buthyl alcohol are rich in vitamins of the B_2 group. Much work is being done to-day in this respect and the possibility exists that adequate provision may be made for the supply of this vitamin in our poultry rations.

Minerals are associated with the formation or production of vitamins, enzymes and hormones essential to life. It has been found that an over-supply of manganese plays a supplementing rôle when Vitamin D is present in poultry rations in sub-optimum quantities.

Old hens require twice as much manganese during laying seasons than pullets do in their first year of production.

It has been found that natural products which in the main, supply the same minerals to fowls, furnish different results. So, for example, it has been proved that oyster shell is a better source of lime to laying hens than, say, ground limestone. In hens fed on ground limestone meal, the mortality was higher and the production lower than in those fed on oyster shell meal.

Interesting data have been released in respect of the composition of the mixture. With the increased use of inferior products in poultry rations the tendency is to grind the mixture too finely. The result is that the fine meal accumulates in the corners of the mouths of the fowls, eventually developing into ulcers. Another argument advanced in favour of the production of a fine meal is that such meal will obviate selective feeding on the part of the birds. Results, however, have shown that poultry enjoy the coarser meal far more than they do the fine meal. Because of the little pieces of husks, oats have taken the place of wheaten bran for this purpose. The oats husks serve to break up the food mass in the digestive organs, making possible the penetration of the digestive juices. It naturally also assists in the peristaltic motion of the intestines.

The foregoing is merely a general survey of the developments in the sphere of poultry nutrition during the war. A consideration of the information that became available during that period, will reveal the rôle played by chemistry in this sphere. Without the aid of chemical services there is no hope for the development of a sound industry in this sphere in any country. In conclusion, it may be added here, that the expansion and devolopment of the poultry-feed industry are very closely associated with the development of our other industries.

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Has Cotton a Place in Our Agriculture?

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TO the question as to whether cotton has a place in our farming, many persons who were concerned with the cotton industry of 20 years ago, would probably reply in the negative. To be able to give a fair opinion, however, it is essential to be familiar with most of the facts which led to the disappearance 20 years ago of a flourishing industry in respect of which great expectations were cherished at the time, an industry well organized in all its phases, and in which capital amounting to over £1,500,000 was sunk.

Reasons for Decline of Cotton Industry.

To gain a fairly good insight into the development of this industry, readers are advised to consult Report No. 92 of 1929 of the Board of Trade and Industries on the "Cotton Growing Industry". This report gives an accurate survey of the industry from its inception in 1909 up to 1928, i.e. its development over nearly 20 years. From 1929, owing to falling prices and the world depression, the industry started falling into decline and up to the present the possibilities of its revival have not enjoyed much attention, notwithstanding the high prices of farm products during World War II.

Superficially, it may be argued that the collapse of the cotton industry in the depression years of 1930-32 with its concomitant heavy losses to farmers, co-operative societies and companies gave farmers such a shock, that there can be no question of the re-establishment of the industry.

This is an unfortunate state of affairs, since a careful analysis of the industry of those days will reveal that round about the years 1929 and 1930, the industry was on the point of being stabilized on a sounder basis. The entire organization was already in existence, but owing to the absence of a sound farming system in the depression years, stabilization could not be effected. Large companies were particularly vulnerable in this respect.

The industry stood at the crossroads, but was soon engulfed in the tidal wave of distress which surged through South Africa during the depression years, and its plight was aggravated by the fact that it had to compete on a world market.

The total annihilation of the industry—except in a small zone in the Barberton area—was precipitated by the excessively dry years of 1931/32 and 1932/33.

To indicate their standpoint in 1928 with regard to the then existing cotton industry, the Board of Trade and Industries, *inter alia,* intimated in its report (1929) its *full confidence in the future of Cotton production in South Africa.*

It adds, however—and this coincides with my view with regard to a future industry:—

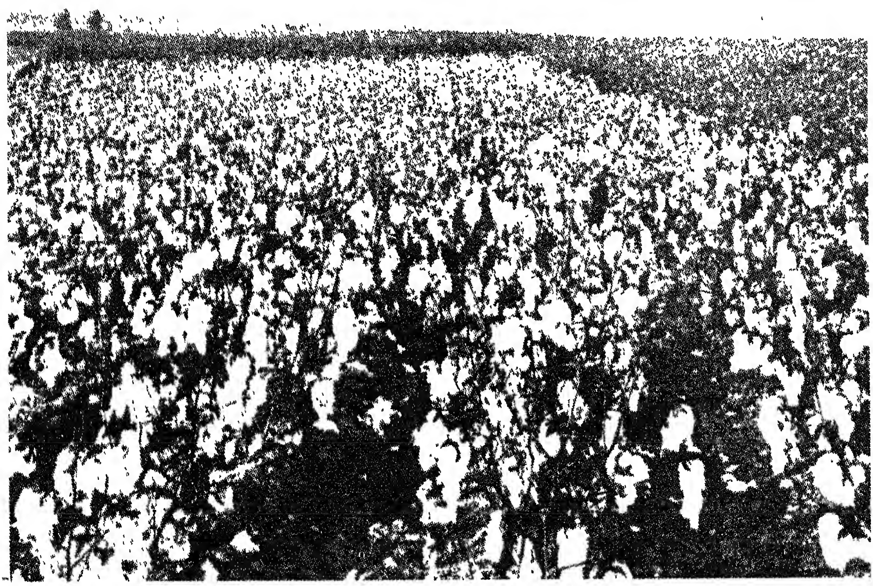
1. That cotton should be grown in a system of crop rotation; and
2. that cotton should on no account constitute a farmer's sole crop. It should be a product of a system of diversified farming.

The question may well be asked—how is it possible that the Department of Agriculture gave no other guidance? It was done, but it must be admitted that a portion—the largest portion—of the production particularly that undertaken by large companies, was modelled to far

too great an extent on monocultural lines, and although the idea was to aply a short rotational croping system, most companies erred by relying almost exclusively on cotton, to be financially successful.

There is also another side to the picture. The established South African farmers who grew cotton undertook it as a subsidiary branch of their already existing general farming. These farmers virtually undertook cotton growing with existing labour and with the bare necessities of additional equipment, and under these circumstances, most of them found it lucrative, especially during the years of high prices. When prices fell, they withdrew without financial loss. These farmers, moreover, were less inclined towards the pursuit of monocultural practices.

As rightly reported by the Board, the investigation brought to light the fact that, without a doubt, the production costs of individual farmers were considerably lower than those of companies.



A Ripe Cotton Field.
(*With acknowledgement to American Cyanamid Co.*)

Plea for Resumption of Cotton Growing.

I feel that it would be in the interests of South Africa, if attention were once again given to this industry, with a view to:—

1. The production of fibre.
2. Making available a source of oil.
3. Making available the residual oil cake for our livestock industry in order to augment our sources of protein.

My contention is that, with a stabilized price, there is scope for the re-establishment of a cotton industry in the lowveld as well as in the middleveld areas. The same areas formerly utilized can once again be harnassed for the industry, except perhaps the very dry lowveld areas. We have already acquired valuable experience, and many of the obstacles of the past can be effectively avoided.

Limiting Factors in Production.

If we examine the limiting factors of cotton production here, leaving out of account factors already mentioned, such as (1) the poor farming systems practised by large companies, (2) the depression years from 1930 onwards and up to about 1934 and (3) the country-wide droughts of 1931-1933, mention should also be made of the following principal limiting factors which all contributed towards the relatively low yields per morgen, viz.:

(1) *Insect pests* such as the Sudan Bollworm, American Bollworm, Jassid, Stainer and also other insect pests which may be regarded as lesser pests compared to these four.

(2) *Diseases* such as boll rot (mainly in wet years).

(3) *Poor soil cultivation* and use of unsuitable soils.

(4) No (or inadequate) applications of artificial fertilizer.

(5) *Late rains*—with a resultant short season, particularly in the middleveld areas where frost occurs towards the end of April and May.

Of these limiting factors, the most important are the *two species of bollworm* and *jassids*, and the most important of the natural factors are the late rains. Experience points to the *Sudan and the American bollworms*, as the most formidable pests in the middleveld and lowveld areas and to jassids as an additional severe pest in the lowveld.

Entomological research unfortunately did not succeed in finding effective control measures against these bollworms. A vast amount of research work has been carried out in this connection at Rustenburg, but without much effect. Neither could entomologists of the Empire Cotton Growers Corporation who were concentrated mainly in the lowveld areas, discover effective treatments. This Corporation carried out most of its work in Barberton, Pongola (Magut) and Louis Trichardt. It established an experiment station at Barberton, which was partly subsidized by the Department. This experiment station continued with research work until recently, but is now being closed down. This institution can, however, be exceedingly advantageously utilized by the Department for the furtherance and re-establishment of the cotton industry.

This corporation merits every praise for its work, particularly that in connection with the finding of host plants of the Sudan bollworm in the lowveld.

It is quite possible that, with the advancement of science, new effective insect control measures will be found for the control of the bollworm pests. If, with the latest insecticides and information at our disposal, the same intensive campaign and research of 20 years ago could now be undertaken, the control of bollworms should not be an impossibility.

As a result of an intensive breeding programme undertaken by the Corporation on Indian varieties at Barberton, a strain of cotton was soon developed with a high degree of resistance to the jassid. The presence of relatively long hairs on the underside of the leaves of the plants prevented the jassids from reaching the surface of the leaves. The variety or type U4 was the first result of this work. The U4 soon became the principal lowveld type and Improved Bancroft, the type for the Middleveld areas where jassids did not constitute such a limiting factor. Variety trials at Rustenburg later proved that U4 gave even better crops in the Middleveld areas than did Bancroft. The quality of fibre from U4 was, however, coarser and the fibre was considerably shorter than that

of Improved Bancroft. Nevertheless the fibre of U4 was a good marketable article with an average length of about $1^{1}/_{16}$ inches as against $1^{3}/_{16}$ inches and even $1\frac{1}{4}$ inches for Improved Bancroft. With the years, the U4 improved in respect of length of fibre and quality, with the aid of research at Barberton.

Along these lines, therefore, one of the big pests of the lowveld, viz., the jassid, was overcome. There still remains the control of the two bollworms. Fortunately, the dreaded American boll weavil has not yet appeared in this country.

A Better Cultural Practice.

Without reverting to the other limiting factors such as Stainers, boll rot, etc., I should like to discuss here, the factor of *late rains*, and to suggest a basis of cultivation for the future, in the event of the re-establishment of the cotton industry, to promote greater stabilization of production.

The instability of our rainfall during October and November is a matter of common knowledge. A survey of the rainfall figures for the different areas will reveal the variability of good rains during these months, which are the planting months for cotton. In the past this was the principal contributory factor in the fluctuations in the morgenage planted and the great variation in production from year to year. In years when good rains are late in coming, e.g. in December, the total plantings for the Union are lower, with consequent low total production and low yields per acre.

This factor cannot be sufficiently emphasized. In my opinion, it is the biggest single limiting factor which kept the Union's average production per morgen so low, viz., 101 lb. fibre per acre for 1925/26 and 73 lb. in 1926/27 and 95 lb. for 1927/28, as against the U.S.A.'s average for 10 years of 155 lb. per acre. For the 6 years ending 1927/28 the Union's average output per acre was 81 lb. and for the 3 years ending 1927/28, 93 lb.

The Board found the consensus of opinion to be that an output of less than 150 *lb. of fibre per acre* is uneconomical and below the average which can be expected in favourable seasons. The yields in the different (6) areas varied greatly, viz., from 6 lb. per acre to over 251 lb. for 1926/27. In the Upington area the yield was the highest in the Union (under irrigation), viz., 700 to 800 lb. of fibre per acre. In the Weenen area, also under irrigation, the average output in 1925/26 was 191 lb. and for 1926/27, 251 lb. This is reasonably good, but can still be improved. In California, Arizona, New Mexico, under irrigation, the yield figures in 1925 were 344, 850 and 288 lb. per acre and in 1926, 385, 353 and 284 lb. respectively. For the other American States the output usually varies under dryland conditions from approximately 140 lb. in Texas, the State which incidentally yields the biggest total crops—to about 240 to 270 lb. in Mississipi, Missourie, etc.

The economic output level must be placed at about 150 lb. of fibre per acre. Can we maintain this output level and how must we set about it? I am convinced that we can do it, provided that:—

(1) The industry is concentrated in the hands of individual growers and not in the hands of large companies interested solely in cotton growing. (Companies intending to follow sound farming practices, need not, however, be excluded).

(2) Better cultural practices are followed than those of the past, with stress being laid on fertilization practices and the inclusion of rotational cropping systems.

The efforts so far made by the Empire Cotton Growers Corporation here and in almost all parts of the British Commonwealth, were aimed at making Britain independent of American supplies as far as possible. Similar efforts are being made by Portugal to-day. Why should we not also build our own cotton industry?

For the successful re-establishment of a cotton industry in South Africa it is essential that production per morgen shall be maintained at a higher level than in the past. Large areas of the Union are suitable for cotton growing.

If cotton growing is included in rotational cropping systems in farming enterprises on the basis of ratooning a portion of the annual plantings each year, production will become stabilized and the disturbing factor of late rains, will largely be overcome. Along these lines it will be possible once again to reach and even surpass former production heights.

With the latest development of insect control measures, we can look forward with optimism to a future in which cotton insects will not constitute such a serious menace.

I feel confident that if such an industry could once again be earnestly tackled on a sound agricultural basis, it could be permanently established in our agriculture, even in competition with world market prices.

Phosphate Studies in Lowveld Soils:—

[*Continued from page* 534.

Screened kraal manure in intimate admixture with either superphosphate, Gafsa, or Langfos has increased the availability of these phosphates. The greatest effect was noted at the end of the nine-week period. Many overseas agricultural scientists have shown that the availability of phosphates has been improved by applying them in contact with kraal manure. In view of these findings this practice is recommended for trial. The kraal manure-phosphate mixture may be prepared months before application. Kraal manure-phosphate ratios of from 10 to 1 to 20 to 1, dependent on crop and soil, should be used.

Results indicate that the availability of phosphate in kraal manure is of a low order. Nine weeks after application of kraal manure to granitic soil, only $^1/_7$th of the total phosphate in the manure had been rendered available. This serves to explain why tomatoes receiving an application of 20 tons per morgen of kraalmanure in the row, developed phosphate deficiency symptoms. Kraal manure alone is a poor source of phosphate for any short-term crop, and should be supplemented by an adequate quantity of phosphatic fertilizer.

All the recommendations given here refer to Lowveld soils only—i.e. to prevailing conditions of high summer rainfall and regular winter irrigations. In the more arid regions of South Africa, moisture, and not phosphate, is the factor limiting growth and production.

Please Note.

"Duck Farming", Bulletin No. 248, which was out of print for a time, has been reprinted and is now obtainable from the Editor ot Publications, Pretoria. Price 6d. per copy.

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NOTE.—Items marked with an asterisk (*), are papers read by professional Officers of the Division of Agricultural, Education and Research at a Conference held in Pretoria, and referred to in an Editorial in the July issue of " Farming in South Africa."

[*Photo on Cover*: Fish Hatchery, Jonkershoek.]

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FARMING IN SOUTH ... AFRICA

VOL. 23 SEPTEMBER 1948 No. 270

Editorial:

Organization in the Seed-production Industry.

MOST FARMERS in the Union to-day are aware of the fact that South Africa now has an established seed industry and that the country is to a very large extent independent of imports for its seed requirements. Many, however, do not yet realize the tremendous possibilities that exist for an export trade and that this seed industry may become a major agricultural industry of South Africa within the relatively near future. The demand from overseas for South African seed was stimulated by the production of good South African vegetable seed. This primary demand for vegetable seed has now also expanded to many kinds of field seeds such as mangolds, sugar beet, sunflower, castor oil, linseed, poppy seed, grasses, clovers and other pasture seeds. For this industry to be a permanent success and a permanent asset to South Africa, two important essentials must be observed: The first is the guarantee of high-grade seed, and the second is a sound production and marketing organization.

Quality is very largely guaranteed by the Department of Agriculture through its inspection service under the control of the Division of Horticulture. Inspectors of this service inspect farmers' crops on the land and advise farmers how to recognise good seed. If the farmer adheres to this advice and gives his full co-operation to the inspection service, then such seed will be certified and thereby be acceptable to the trade. With the tremendous expansion of the seed industry it has become necessary to appoint more and more inspectors, and this expansion is expected to continue for a considerable time. The expenditure involved in connection with this inspection service is considerable, and the time has come for grower's organizations to consider the desirability of contributing towards the cost of this service. As in the case of many other agricultural commodities, it may become necessary to impose an inspection fee to be paid by producers of seed. A satisfactory basis for imposing this fee requires the consideration of growers.

A sound growers' organization is just as essential to the success of this industry as a sound inspection and certification organization. It is, for example, essential that growers band themselves together, as they have already very largely done, and through their organizations maintain sound marketing methods. It is immediately obvious that it is desirable for seed producers to market their products through one channel, and a central organization for seed growers, therefore, becomes essential. Such an organization already exists, but it needs emphasis to impress on growers the necessity for supporting such an organization and keeping it an active, strong organization, which can look after the interests of all.

By working through organizations instead of as individuals, the creation of facilities for cleaning and testing seed can also be created by the growers. It is impossible for individual growers to acquire expensive cleaning and testing equipment, but this aspect is just as important to a successful seed industry as the production aspect.

Farmers who propose to go in for seed production should apply for registration to the Division of Horticulture, P.O. Box 994, Pretoria, so that all facilities can be put at their disposal and so that inspection and certification can be thoroughly organized. Whenever possible, this should all be done prior to the actual planting of the crop.

(Dr. F. G. Anderssen, Chief Division of Horticulture.)

Allotment of Government Guano.

ONLY one allotment of guano will be made for the year 1949, commencing in April, but earlier if circumstances permit.

The guano which will be available for disposal in this allotment is limited for distribution to *bona fide* farmers within the Union who are to produce only wheat, vegetables, onions and potatoes. For no other type of crop will guano be available.

Applications for an allotment of guano must be submitted on the revised prescribed form U.A.D. 228 (the old form is obsolete and will not be accepted), to the Superintendent, Government Guano Islands, Van Riebeeck Chambers 32, Riebeeck Street (P.O. Box 251), Cape Town, before noon on the 30th October, 1948, after which date no application will be accepted in respect of this allotment. (Telegraphic applications will in no circumstances be considered.)

Completed application forms must be signed before a Justice of the Peace or Commissioner for Oaths by the person requiring and entitled to the guano. (Incomplete forms will be returned for completion.)

Applicants for guano are notified that in submitting applications, the purpose for which the guano is required and the area, in morgen, under cultivation must be stated on the application form. Applications must be submitted by registered owners or lessees actually carrying on farming operations; only one application will be accepted in respect of any one farm, or group of contiguous farms, of the same owner or lessee.

Guano allotted will have to be taken up and paid for not later than the 30th September, 1949, after which date it will not be available.

The price of guano is £10 per ton of 2,000 lb., or 20s. per bag of 200 lb. net weight when packed, delivered in bags, free on rail, or on board ship, Table Bay Docks. Minimum quantity supplied, 200 lb. A subsidy of £1 per ton is allowed by the State, so that the actual price to the applicant is £9 per ton or 18s. per bag. Railage or freight is payable by the applicant to whom the guano is consigned, but railage must be prepaid when guano is consigned to a railway siding. In no case will guano be consigned or delivered to any person other than the applicant to whom an allotment has been made.

Payment will not be accepted for guano until allotment has been made.

Inquiries in connection with the allotment of guano must be addressed to the Superintendent, Government Guano Islands, P.O. Box 251, Cape Town, from whom application forms are obtainable.

A New Bulletin.

Bulletin No. 284. The Feeding of Farm Animals (1. Dairy Cattle) has been published recently. It is obtainable from the Editor of Publications, Pretoria, at 3d. per copy.

Bush-Clearing for Nagana Control in Zululand.

Ernst du Toit, Principal Professional Officer, Division of Soil Conservation and Extention.

THE Department of Agriculture is at present conducting in Zululand a campaign designed to eradicate once and for all time the tsetse fly, the carrier of the dread cattle disease, Nagana, which has already caused enormous losses to farmers. At the request of the Division of Veterinary Services, which is in charge of the campaign, the Division of

FIG. 1.—General view over a portion of the Umfolosi Game Reserve. It was in this reserve that game extermination was applied as a method of tsetse-fly control. In this reserve are to be found approximately 230 white rhinoceros, which it is felt must be preserved at all costs.

Soil Conservation and Extension has undertaken the bush-clearing part of the measures necessary to control and exterminate the fly, and for this purpose has built up a considerable organisation which is at present engaged upon the necessary bush-clearing measures.

FIG. 2.—Bush-clearing in the southern buffer zone of the Umfolosi reserve. Scrub forest and dense thickets occur in this area.

Scope and Object of Operations.

The bush-clearing operations include the following:—

1. The clearing of bush-free barriers, two miles wide, around the Umfolosi and Hluhluwe Game Reserves in order to prevent tsetse fly within these reserves from escaping to surrounding areas. The area to be cleared to form such barriers is approximately 193,000 acres in extent. Since the commencement of the operations an area of over 100,000 acres has been cleared.

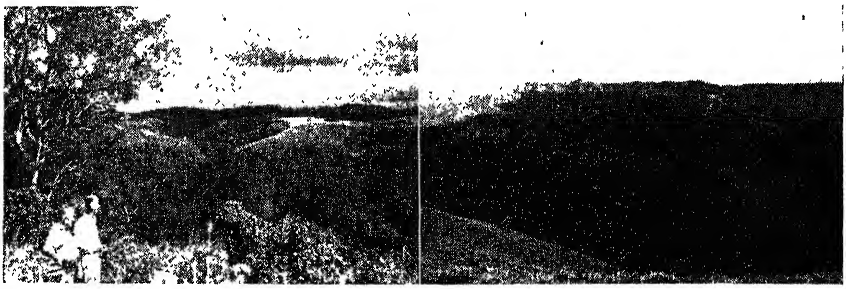

FIG. 3 and 4.—The type of forest country occurring in the barrier zone around the northern and eastern sides of the Hluhluwe Game Reserve. The clearing of this forest country is a difficult undertaking, but the barriers must be cut to safeguard the areas surrounding the reserve. This type of forest country was the home of *Glosina brevi palpis*—the forest tsetse fly.

2. The clearing of thickets and undergrowth, known as selective or discriminative thicket clearing, along rivers and streams in northern Zululand, outside the reserves, and thereby destroying known and suspected tsetse-fly breeding places. This work is being undertaken largely in areas where direct attack on the fly by means of smoking out with D.D.T. from aircraft or ground generators is impractical or considered not wholly effective. The major portion of the breeding thickets along the Pongola and M'kuzi rivers has already been completed.

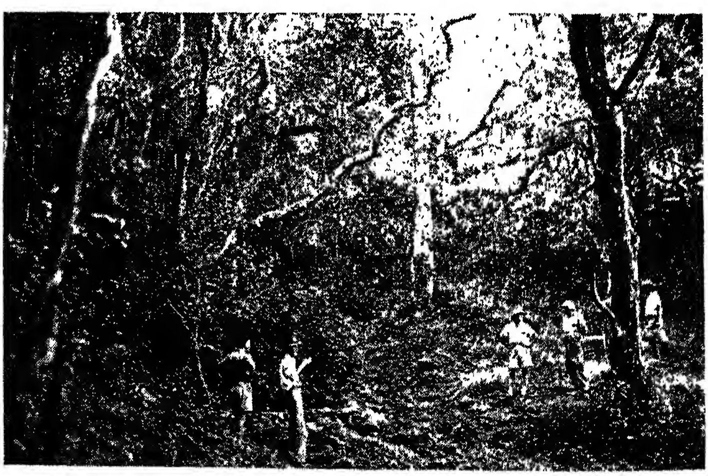

FIG. 5.—Dr. Ross and his party having a well-deserved cup of tea after climbing out the Vivi forest in which bush-clearing is being undertaken.

3. The clearing of two-mile wide barriers across the poorts of the M'sunduzi, M'Kuzi and Pongola Rivers where they enter the Ubombo range on the western side. The object of these clearings is to prevent the infiltration of flies from the M'Kuzi reserve, east of the Ubombo range, through the poorts to fly areas west of the range. So far only the barrier across the M'sunduzi poort has been completed. It is considered that it may not be necessary to cut the barriers across the other two poorts, owing to the great success achieved in exterminating the fly in the M'Kuzi reserve by D.D.T. smoking from aircraft.

FIG. 6.—Recovering Red Ivory timber from bush-clearing operations in Zululand. All saleable timber is recovered and sent to the State Sawmills, Pretoria.

The Departmental campaign to eradicate the tsetse fly and stamp out Nagana is meeting with success, and it is confidently expected that the death knell of the tsetse fly in South Africa has been sounded.

FIG. 7.—The Foreman-in-Charge of operations in the Hluhluwe sector with his wife, beside their temporary home. Gangs are supplied with wireless instruments for communication with headquarters.

An Inspection Tour Through Zululand.

Recently, Dr. J. C. Ross, Director of the Division of Soil Conservation and Extension, undertook a tour of inspection of the fly areas and bush-clearing operations, and the accompanying photographs, taken during the tour, depict scenes of the country, and of the operations in progress.

FIG. 8.—Dr. Ross being shown typical fly thickets prior to selective clearing.

FIG. 9.—Typical fly country in northern Zululand after selective thicket clearing. Note the pile of slash on the left which has been stacked on the contour to stop erosion. This country was the home of *Glossina pallidepes*—the thickets tsetse fly.

FIG. 10.—Zululand grows some of the finest grass to be found in the Union. Note the height of the rooigras.

FIG. 11.—Miles of waving rooigras and buffelgrass after the removal of light bush—Hluhluwe sector. Fortunately grass immediately takes the place of bush when the latter has been removed.

Nutrition of Poultry.

Bulletin No. 260, "Nutrition of Poultry" by Prof. A. M. Gericke, which was out of print for a time, has been reprinted, and is again available.

It is obtainable from the Editor of Publications, Pretoria, at 6d. per copy, post free.

Spray Programme for Pears and Apples.

Dr. W. A. K. Stubbings, Western Province Fruit Research Station, Stellenbosch.

RADICAL changes in the spray programme for codling moth control have been made during the past two seasons in the western Cape Province as a result of the introduction of formulations of D.D.T. suitable for codling moth control. The price of various brands of wettable D.D.T. has become so reasonable during recent months, that many of the older spray materials, such as lead arsenate, fixed nicotine and natural cryolite, are virtually disappearing from the market.

(1) *Lead Arsenate.*—The time has now arrived for growers to discard lead arsenate for codling moth control. As the insect in the western Cape Province during the past thirty years developed a degree of resistance to arsenic, the kill of newly hatched larvae has become unsatisfactory, particularly during the summer. Lead arsenate is also a slow-acting stomach poison and is therefore unable to prevent superficial damage by a high percentage of larvae that bore through the skin of the fruit and subsequently die. Lead arsenate often causes foliage injury to apples and pears, particularly during the spring when it is used in combination with lime sulphur to control Fusicladium, and a considerable quantity of water-soluble arsenic is formed by the chemical reaction of these materials in the spray tank.

Growers are again warned against marketing fruit carrying arsenical loads in excess of the official export tolerance of 0·01 grs AS_2O_3 per lb. in the case of export fruit, and 0·02 grs AS_2O_3 in the case of pears destined for the local market.

As the resultations against excessive arsenical residues are being far more rigorously enforced, than was possible during the war years, growers cannot afford to take any risks with residues. In view of the possibility of prosecution, retailers are becoming chary of handling fruit, especially dried fruit, which has been sprayed with lead arsenate. The wisest course undoubtedly is to avoid the use of lead arsenate altogether.

(2) *Fixed Nicotine.*—Although this spray material is safe to foliage and fruit, and does not promote residue removal difficulties, it is not markedly superior to lead arsenate as an insecticide against the codling moth. It is incompatible with alkaline spray materials such as lime sulphur. Its chief drawback is its high cost, approximately three times that of lead arsenate at correspondingly effective dosages.

(3) *Natural Cryolite.*—This material is of the same order of effectiveness as lead arsenate, is also somewhat slow in action as a stomach poison and has poor adhesive qualities. It is unsuitable for use on pears destined for export, as British regulations will not permit the import of fruit with even the smallest traces of fluorine in the form of spray residue.

(4) *Summer oil emulsion.*—This spray material is an ovicide which has contributed greatly to the effectiveness of spray programmes in the past, being added to stomach poisons, such as fixed nicotine, at times when large numbers of codling moth eggs are present in apple and pear orchards.

Its extensive use during the summer months has led to an undesirably large degree of spray injury.

Apples are particularly susceptible to oil injury, severe sunburn of the fruit and bark injury often occurring during hot spells. Pear trees in the hot interior valleys have also sustained severe bark injury through the excessive use of summer oil sprays.

Where summer oil emulsion is used in combination with D.D.T., a yellowing of the foliage occurs which may result in premature defoliation. It is fortunate therefore that the inclusion of summer oil in spray programmes for apples and pears is no longer necessary.

(5) *D.D.T.*—Dichloro-diphenyl-trichloroethane (D.D.T.) has proved to be the most effective chemical yet used for codling moth control. Its effectiveness is due to its many modes of action on several stages in the life history of the insect.

Advantages and Disadvantages of D.D.T.

D.D.T. is a most effective stomach poison. It is sufficiently persistent to protect growing fruit from entry by newly-hatched codling moth larvae for a period of around three weeks. Its action is extremely rapid, and the superficial type of injury associated with the older insecticides, such as lead arsenate, is virtually absent. It is also a potent nerve poison and many of the newly-hatched larvae succumb to contact action while merely crawling over the sprayed fruit surface when seeking a suitable place of entry. Half-grown larvae migrating from one small fruit to another will also be killed by the protective D.D.T. coverage.

Suggested spray programme.

Stage or Approximate Date.	Spray mixture (per 100 gal. of water).
Green-tip stage....................	Pears, Lime Sulphur, 5 gal. Apples, Lime Sulphur, 1¼ gal.
Green cluster in Pears, pink-bud in Apples.	Lime Sulphur, 1¼ gal.
At least ¾ petal drop. (1st Codling moth spray).	Wettable D.D.T. (50 per cent.) 2 lb. Lime Sulphur, 1¼ gal.
14 days after previous spray. (2nd Codling spray).	Wettable D.D.T. (50 per cent.) 2 lb., wettable Sulphur, 5 lb. (Neutral compounds such as Copper Oxychloride or Copper-Hydro can be used instead of wettable sulphur in the case of pears.)
21 days after previous spray. (3rd Codling spray.)	As previous spray.
Around 8th December. (This date will vary according to locality and season.) (4th Codling spray.)	Wettable D.D.T. (50 per cent.) 2 lb.
14 days after previous spray. (5th Codling spray).	As previous spray.
21 days after previous spray. (6th Codling spray.)	As previous spray.
21 days after previous spray. (7th Codling spray.)	As previous spray.

The final spray suggested above may be omitted provided that the orchard is entirely free from infestation up to the middle of January. Before deciding to omit this spray, growers should consult the Western Province Fruit Research Station.

D.D.T. has a remarkable effect on the moth stage of the insect. Not only does it act as a deterrent to egg-laying, but is known to kill a very high percentage of the moths actually hit by the spray.

There are a large number of formulations of D.D.T. on the South African market, most of which are unsuitable for use on growing plants. Of the various forms tested against the codling moth only two have proved suitable, viz. emulsions of solvents, such as solvent naphtha containing D.D.T., and wettable powders.

Although D.D.T. has many of the characteristics desired in a perfect insecticide it has one very important weakness, namely its high toxicity to a number of beneficial insects. Special precautions have to be taken during the blossoming period of fruit trees to prevent the destruction of bees, syrphid flies and other valuable pollinating insects.

A number of valuable insect parasites and predators in apple and pear orchards are destroyed by D.D.T. Pests such as the Bryobia mite, red spider and woolly aphis which are relatively unaffected by D.D.T. are found to increase rapidly in numbers in orchards where this spray material is used. Special measures for the control of mites have to be carried out in these cases. It seems, however, that the increase of woolly aphis in most apple areas is of a very temporary nature.

The small wasp parasite *Aphelinus mali* re-establishes itself in large numbers soon after the final D.D.T. spray in summer, and reduces the high woolly aphis population to normal proportions by autumn.

Special Measures for Control of Orchard Mites.

Bryobia mite.—Where growers intend to use D.D.T. for codling moth control, precautions should be taken to reduce the orchard population of Bryobia mite during winter. Thus a winter spray of the following formula should be applied during late August.

Winter oil emulsion: 4 to 5 gallons.
Lime sulphur: 4 to 5 gallons.
Water to make up 100 gallons spray mixture.

or

Winter oil emulsion: 4 to 5 gallons.
D.N.O.C. powder (50 per cent. D.N.O.C.): 2 lb.
Water to make up 100 gallons spray mixture.

Where this winter spray is thoroughly applied, it should not be necessary to apply further control measures against the Bryobia mite until summer. If it is noticed during December that a rapid increase in the mite population is taking place, 1¼ lb. DN-111 or ½ gallon Dynone per 100 gallons should be added in the 5th or 6th codling moth spray.

When winter spraying is omitted it will probably be necessary to commence the use of DN-111 earlier in the season, viz., with the 3rd. codling moth spray.

Red spider.—This pest continues to breed throughout the whole year on weeds, windbreaks and other plants in and around fruit orchards. It may appear on the trees in large numbers any time during spring or summer, and may cause severe damage to both fruit and foliage in the

[*Continued on page* 628.

Quantity or Quality in Seed-Production.

J. F. van Wyk, Horticulturist, Upington.

THE seed industry in South Africa has already met with a large measure of success thanks to the singleness of purpose with which the organised farmers have tackled it. It has repeatedly been proved that South Africa, with its eminently suitable climatic and soil conditions, is in a position to produce a large variety of seeds of excellent quality. South African seed has also attracted the attention of foreign seedsmen. Export is essential to the stabilisation of the industry, but when we commence exporting, we come into competition with other seed-producing countries and with unrestricted importation, this competition will be evidenced on the home market as well. Price and quality will then decide who will triumph.

During the past years when seed was cultivated on a relatively small scale, principally for the home market, and high prices were obtained generally, growers showed a handsome profit even from a poor yield per morgen. Now that, with the removal of the war-time restrictions, the seed trade is once again controlled by international supply and demand, growers are finding that the competitive prices are considerably lower than previously, and local growers are not in a position to do much in the matter. The only solution is to devote more attention to better methods of production in order to ensure higher yields per morgen and bring the ultimate turnover up to the correct level again. Larger yields can be obtained only when the soil is most effectively cultivated and fertilized. The enhancement and maintenance of soil fertility is a matter of primary importance. When, under the latter circumstances, a profitable income cannot be obtained from the cultivation of a particular plant, it would be advisable immediately to discontinue the production of such a plant.

The danger exists that in mass production of seed, growers will emphasize on quantity rather than on quality. Until recently there was a sale for seed of doubtful quality. On account of the serious shortage which arose during the war years and immediately afterwards, merchants were sometimes compelled to buy such seed. Meanwhile, however, the position has changed and the quality notch is very high at present, since the consumer must also be protected. The responsibility rests with the numerous seed growers in our country who, as primary producers, in the main, determine the quality of South African seed. Good seed should, in brief, comply with the following requirements:—

(1) *High Germination Capacity.*—Factors which adversely affect germination are the following:—

(*a*) *Poor Production Methods.*—Exhausted soil produces poor plants which give poor and undeveloped seeds. Diseased, or insect-infested, or weed-choked plants give the same result.

(*b*) *Ineffective Harvesting Methods.*—Seed which is harvested when too green, has not been sufficiently dried before storing, or is exposed to the rain while harvesting is proceeding, will show impaired germination.

(c) *Ineffective Storage.*—Weevil-damaged seed and seed stored under damp, inadequately ventilated conditions, cannot give good germination results.

(d) *Age.*—Most species of seed will show a reduced germination capacity after the second year. By avoiding over-production and the consequent carrying over of seed from one year to the next, this possibility may be precluded.

(2) *Good Viability.*—Seeds which germinate rapidly and produce strong plants testify of a high viability.

(3) *Trueness to type.*—The seedsman, who takes an interest in his work, will always be sure to cultivate those seeds which are most true to type. Each species and variety of seed has its own peculiar characters to which it must conform. Cross-pollination between related plants must be entirely avoided by taking the necessary precautions.

(4) *Freedom from Impurities and Disease.*—The presence of broken or insect-damaged seed, weed seeds, pebbles and any other rubbish is most undesirable. There is always a sale for seed 100 per cent. pure. Certain diseases as, for example, bacterial wilt of beans, are transmitted by seed. Such seeds must be discarded.

(5) *Appearance.*—Sound, full, lustrous seeds are attractive and are evidence of the ideal conditions under which they have been produced.

The South African seedsman to-day finds himself in a very favourable position in respect of the oversea's market. In comparison with the most important seed-producing countries, South Africa is still in the fortunate position that labour costs have not risen unduly. The seedsman is, therefore, still able to attend personally to the production and cleaning of seed, which is not the case in other seed-producing countries where mechanical mass-production has become essential.

Good quality seed can be produced only where careful personal attention is given to the development and selection of the plant. It is precisely this fact which makes it possible for South Africa to furnish seed of quality. There is nothing to prevent the seed industry from becoming one of our largest agricultural branches. Growers have all the means at their disposal and everything will depend on whether they utilize these to the best of their ability. When every seed plant is cultivated under suitable conditions, both as regards soil and climate, and scrupulous attention is given to harvesting and cleaning, not only the quantity but also the quality will be assured.

Poultry Farming.

Bulletin No. 241. *Poultry Farming in S.A.* which was out of stock, has been reprinted and is again obtainable from the Editor of Publications, Pretoria.

(Price 1s. per copy, post free.)

Registration of Vine Nurseries.

Prof. S. J. du Plessis, Stellenbosch-Elsenburg College of Agriculture, Stellenbosch.

DESPITE any arguments which may be advanced against the local inspection systems, and the grounds on which quarantine measures may be introduced, it is universally admitted that the future of any industry cannot just be left to the fortuities of the trade. This is true, especially of a trade which must supply the essentials for an industry. In agriculture this would refer in the first place to the purchase of vegetable and animal material from which the income of the agricultural industry is to be derived.

Since the problems to be considered are so numerous and so often of an involved nature, the need has definitely arisen for the industry to be assisted in the inspection of its fundamental material by persons

FIG. 1.—Certified vines displayed for sale.

who make it their life-work to guard against visible and sometimes invisible dangers threatening the interests of the industry. The fact that so many different agricultural institutions have already united in requesting the Department of Agriculture to create ways and means for and to render assistance in, the selection and supply of their planting material, is evidence that this assistance is being increasingly appreciated. Vegetable, potato, fruit and even wheat-farmers have repeatedly urged it, and co-operate with officers of the Department to safeguard their future.

It is encouraging to notice that since the Department has taken the lead in applying certain inspection measures for vine nurseries, so many wine farmers have already given liberal support. This support is essential to the successful operation of any control service. It is fully realized

that no agricultural officer can succeed in the succesful operation of control measures without first gaining the co-operation of the farmer. In respect of the supply of material for plant propagation to the wine farmer, we are really concerned with two groups of interests. I wish to touch briefly upon the responsibility and attitude of each of these.

The Vine Grower as Seller.

In the wine industry, practically all the vine growers are also wine farmers. This is in some respects, very fortunate. The vine farmers are, therefore, vitally concerned in the industry; they are acquainted with the needs of the vine and should be keenly solicitous about the future of the practical aspect of the industry.

It should be the endeavour of every grafter without exception, to place the reliability of the service he gives the industry at the highest possible level, not only because he wishes to satisfy the buyer of his vines during the brief transaction, but because he also feels strongly for the future of the industry. Apart from his own efforts to increase the reliability of his service, he can and should avail himself of the services which the Department of Agriculture places at his disposal. It is gratifying to be able to state that during 1947-1948, 266 nursery proprietors availed themselves of these facilities and applied for registration of their nurseries.

The vineyards and nurseries of all vine growers who apply for registration are carefully examined by plant inspectors during the year of registration for the special purpose of deciding whether or not the mother plantations or the nurseries are infected with bacterial blight. If both the source of the vines and the nursery itself are free from disease, the Department certifies accordingly, and such a certificate entitles the grower to attach certification tags to his consignments of vines. The presence of these consignment tags should, therefore, be regarded by the buyer as further assurance that his purchase is attended by the least possible risk.

Application for Registration.

The Agricultural Pests Act provides that anyone who, *inter alia* wishes to sell or *alienate* (i.e. to give without selling) vines for planting shall be regarded as a nurseryman, and must as such, apply for registration. This registration is valid for one year only and must be renewed annually before 1 September. This makes it necessary for persons who wish to offer vines for sale during the following winter to apply to the Chief Plant Inspector, Plant Control Service, Box 513, Pretoria, who will supply him with two application forms both of which he must complete and return together with a registration fee of £2, before 1 September.

Although this date is given as the last day for registration, vine growers are allowed an extension to 31 January on the understanding that an additional amount may be charged if a special inspection journey proves to be necessary. This, however, very seldom happens.

It is most important to remember that *no application for registration received after* 31 *January will be granted.* This rule was made in order to give officers sufficient opportunity to inspect the vineyards of all registered growers before the fall of the leaves in autumn.

Use of Nursery Tags.

During the course of the year a number of plant inspectors visit the grower's farm and inspect his vineyards and nurseries. If no bacterial blight is detected he is informed later in the season that he may use

the official nursery form on which he declares that the vines referred to have been grown in a registered and certified nursery.

Upon receipt of the prescribed fee (1/6 per 100 tags) these nursery tags are distributed on application at the end of the growing season and before the beginning of the vine sales. The rule applied at present is to supply to the registered grower just sufficient tags to cover the sale of grafted vines and cuttings during the current season. Every nursery tag for distribution to growers bears the registration number and the date-stamp of the Department.

The tags are obtainable after inspection of the nurseries, from the Principal, Stellenbosch-Elsenburg College of Agriculture, Stellenbosch.

The regulations require all consignments of vines to have the above-mentioned tags or certificates attached. This, of course, applies to every individual parcel sent by post. Since vines are usually sold and dispatched

FIG. 2.—Public auction of certified vines in the Western Cape Province.

in bulk there is a regulation to the effect that at least every batch of 500 fair sized vines must bear a tag. If vines are delivered in smaller volume to individual buyers, each individual parcel must display a tag.

Granting of Special Transport Permits.

In addition to registration and the use of nursery tags, there is a transport permit system in operation. The districts in which bacterial blight occurred have been proclaimed. They are Somerset West, Stellenbosch, Worcester, Wynberg, Robertson and Caledon. Irrespective of registration, no vines or grafted cuttings whatsoever may be removed from a nursery or vineyard unless the consignor is in possession of a special permit authorizing such transportation. According only to the present system, the permits are granted only to owners of vineyards, which were inspected during the season and found to be free from bacterial blight, on the understanding that permits are not granted to owners of farms which are dangerously near to farms infested with this

disease. Actually, special permits are granted only to growers, whose nurseries or mother plantations are in the above-mentioned districts, and after inspection are passed for certification. The issue of permits, therefore, largely served as an additional assurance to buyers that vines, obtained from proclaimed districts are safe to plant as far as the Department can determine.

If, therefore, a person receives vines from anybody else in a declared district, it is obviously his duty to assure himself that the consignor is in possession of the required permit. If he receives and/or transports vines from a person in any of the proclaimed districts who does not possess the necessary permit, both he and the supplier are legally liable to prosecution. In any case, the nearer the place of delivery is to the infected farms, the greater the risk of transmission of bacterial blight. The fact that districts are proclaimed is an indication of this danger. Anyone who disregards it, commits an offence not only against the State and himself, but an unpardonable sin against his neighbours and descendants.

Supplying Grafting Wood.

It would appear that considerable uncertainty still exists on the question of whether or not it is necessary for the person from whom the scions are taken to be registered as a nurseryman. From the outset it was realized that the inspection of the source of nursery material was more valuable than that of the nursery itself; consequently it is most disirable to have all such premises registered as nurseries. This registration should be effected during the year preceding that in which scions are to be taken, and this therefore makes it necessary for grafters to decide a year in advance what they wish to graft and from whom to obtain their requirements. The majority of vine growers have specific farms from which they regularly obtain their scions. Such growers need only satisfy themselves that the owners of those farms register regularly every year. The position is more difficult in the proclaimed districts where no vines or scions may be removed from any farm without a permit. Such permits are issued for the removal of scions only from farms inspected during the previous season. The fact that a grafter receives a permit for his own nursery, does not entitle him to obtain scions from an unregistered farm.

It may be argued that the source of the grafting may be divulged to the inspectors before inspection of the vineyards commences, but this would not remedy the mistake if the grafter has quite innocently perhaps obtained his scions from the danger areas. In such a case the Department will be compelled to withhold certification—in spite of the expenses the farmers may have incurred in grafting.

The safest and surest way for any grafter is to obtain his material from registered persons only, or to make sure a year in advance, that the person from whom he wishes to obtain scions is registered, irrespective of whether the district has been proclaimed or whether he is buying or receiving the material as a gift.

The registration procedure explained above may appear somewhat clumsy, but the experience of nearly all registered growers is that it works smoothly once the grower understands it, and that at the end of the season he may offer his product for sale with confidence and assurance. In any case the correct procedure is infinitely to be preferred to smuggling methods of disposal, attended by the fear of detection and the unpleasant results of a prosecution.

The Vine Farmer as Buyer.

Individually considered, the interests of the buyer of vines extend further into the future than those of the nursery proprietor who sells. The latter's interest as far as the sale is concerned, ends with the transaction, at which point that of the farmer only begins. From this point onwards the vine farmer faces a series of fairly considerable disbursements for which he hopes to be compensated at a much later stage. The buyer can, therefore, not be blamed, if, during the transaction he is rather fastidious, for he is making an investment and not begging, and in addition to his own keen judgment in the choice of vines, he may to-day avail himself of the facilities offered by the Department.

Applications for the registration of vine growers are carefully checked, the sources of scions traced and the vineyards in the nurseries and mother plantations examined as thoroughly as possible. At the end of the season a distinctive badge—in the form of nursery tags—is issued only to the growers who, as far as could be determined, are able to supply a safe product. This is a substantial safeguard for the buyer's own livelihood and that of his neighbours.

What justification could there be for anyone to disregard these safety measures and to purchase vines or scions from a grower who is not registered and cannot offer this safeguard to the buyer? No wonder vine farmers, who feel very strongly on this matter, are seriously perturbed by the thoughtlessness of a neighbour who displays such utter indifference, not only to his own future happiness and success but also to that of his neighbours.

The sole object of nursery registration and vineyard inspection is to promote the interests of the vine farmer. Its effectiveness depends first and foremost upon the co-operation of the grower as seller and the vine farmer as buyer. Unless both adhere to the prescribed procedure the scheme as a safeguard, will in spite of legal compulsion be doomed to the detriment of the vine industry.

Remember the last date for registration is 31 January! Every intending seller should register in order that there may be enough suppliers to meet the requirements of the industry.

New Bulletins.

Bulletin No. 284.—*The Feeding of Farm Animals (Dairy Cattle)*, by J. C. Bonsma, Division of Agricultural Education and Research, is obtainable from the Editor of Publications, Department of Agriculture, Pretoria. Price 3d., prepaid.

Bulletin No. 229.—*Soft-Cheese and Cottage Cheese* (Second and Revised Edition), by G. D. le Roux, Division of Dairying, is obtainable from the Editor of Publications, Department of Agriculture, Pretoria. Price 3d., prepaid.

Bulletin No. 286.—*The Litchi in South Africa* by Dr. R. H. Marloth, Division of Horticulture, is obtainable from the Editor of Publications, Department of Agriculture, Pretoria. Price 6d., prepaid.

Investigations on the Cracking of Ohenimuri Apples.*

Dr. A. J. Louw, Western Province Fruit Research Station, Stellenbosch.

THE Ohenimuri is the most commonly cultivated apple variety in the western Cape Province. A very general complaint in regard to this apple is its susceptibility to the cracking disease, as it is generally known. This phenomenon consists of a russeting around the stem-end cavity of the fruit and the development of deep cracks, mostly around the stem end but sometimes also on the cheek of the fruit. Some growers claim to have completely eradicated the disease by the application of lime-sulphur sprays, others again, are of opinion that spraying with fungicides has no effect on the disease. In some years and in some regions, especially in the drier inland areas, this phenomenon has assumed such dimensions that, in spite of heavy crops, the cultivation of the Ohenimuri apple is not profitable.

Findings of Research-workers.

At the time before Union, Pole Evans (1907) described a similar apple disease, which was found mainly on the Russet and Rome Beauty varieties in the southern Transvaal and Orange Free State. He ascribed the disease to the fungus *Coniothecium chomatosporum*, Corda which occurred also on the trunk and branches of the tree. According to him, the disease can easily be eradicated by spraying with Bordeaux mixture.

Van der Byl (1914), ascribed a similar disease to the *Coniothecium* fungus and recommended spraying with copper sulphate in winter and Bordeaux mixture in summer. The disease was also ascribed to *Coniothecium* by Massee (1915), in England, and by Cunningham (1925), in New Zealand. Both Van der Byl (1915) and Massee (1915), however, also found fruiting bodies of a *Phoma* sp. associated with *Coniothecium*, and concluded that *Coniothecium* merely represents a stage in the development of the causal fungus. The identity of the causal organism was further obscured by Massee's finding that *Diaporthe ambigua* Nits. was also associated with the disease.

Apparently the isolated organisms were never used in inoculation tests and the findings of various overseas workers have since given rise to uncertainty as to the parasitic nature of this disease. Campbell (1928) and Goodwin (1929) in New Zealand, for instance, were of the opinion that the trouble was more the outcome of a general debility of the tree, and that the *Coniothecium* disease was merely an after-effect. Goodwin stated that many New Zealand growers had topworked Dunn's Favourite (which is the same as the South African Ohenimuri variety) to other varieties on account of its susceptibility to cracking and because they did not consider any of the current remedies effective against the disease. As a counter measure he suggested increasing the resistance of the tree by proper fertilizing, pruning and soil conservation.

* The writer wishes to record thanks to Mr. P. J. J. Prins, Extension Officer, Robertson for his much appreciated co-operation in the orchard experiments conducted in the Montagu district.

In England, Moore, Steer and Shaw (1939) were also of opinion that apple crack is a physiological disease, associated with insufficient soil moisture, available potash and possibly also other factors. According to these authors, the superficial russeting of the fruit, which accompanies the cracking, is merely a further symptom of the above-mentioned deficiencies and may be the direct or indirect result of solar radiation as a result of the scant foliage usually characteristic of such trees.

In America, Leif Verner (1938) made a histological study of cracking in Stayman Winesap apples. He came to the conclusion that in this variety cracking was due to a premature cessation or restriction of growth in the tissue just underneath the epidermis of the fruit as a result of which the outer or skin tissue cannot yield to the internal pressure of the developing cortex or pulp of the fruit. He considered this prematurely restricted growth of the skin tissue to be associated with exposure of the fruit to the sun and atmospheric conditions.

Since 1940, certain researches have been conducted in the western Cape Province on the cracking of Ohenimuri apples. In view of the large number of enquiries that are being received about possible control measures for this trouble, the most important results so far obtained, are given below.

Is Apple Crack Caused by a Fungus?

To determine whether the disease is caused by a parasite, an attempt was made to isolate possible causal organisms from the affected parts of fruit on artificial culture media. No organisms were isolated from

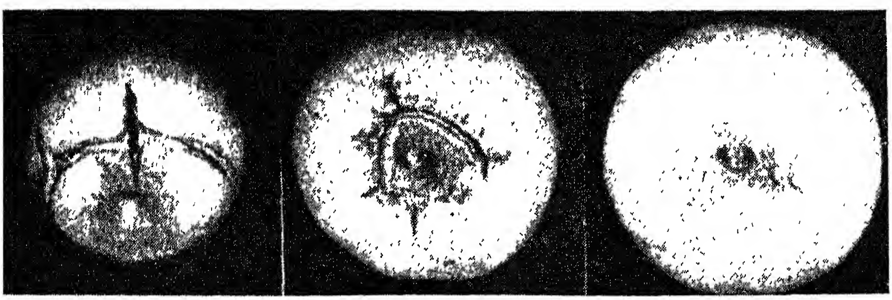

FIG. 1.—Various degrees of russeting and cracking of Ohenimuri apples.

affected parts of the fruit, in the early stages of russeting but in the more advanced stages, when cracks had already appeared in the stem-end cavity, several species of fungi were obtained, viz., *Aspergillus, Cladosporium, Clasterosporium, Coniothecium* and *Macrosporium*. The relation of these fungi to the affected tissue as revealed by microscopic examination gave the impression that they were all secondary intruders and not primarily responsible for the russeting and cracking of the fruit. The origin of the hyphae could generally be traced to an entry by way of open cracks in the stem-end cavity of the fruit. In the case of young fruit, in the initial stages of russeting, no fungi were observed in the affected parts.

The *Coniothecium* sp. to which this disease had been ascribed, was seldom isolated from the fruit and only in one instance from a shoot of an apple tree which showed the characteristic blister symptoms described by Van der Byl (1914). Inoculation tests conducted with this fungus on young Ohenimuri apples, shortly after the setting of the

fruit, gave negative results. Inoculated apples did not develop the characteristic cracking, and russeting was not more marked than in the fruit which had not been inoculated.

The microscopic investigations further revealed that the structural development of the tissue in relation to russeting and cracking of the Ohenimuri apple, was similar to what Leif Verner found for the Stayman Winesap variety. In severely russeted fruit with cracks starting in the stalk cavity, the hypodermal cells were suberised and mostly dead. As the fruit swelled out, these cells became increasingly elongated and flattened until they were torn apart. (See figure 2.) In fruits at the

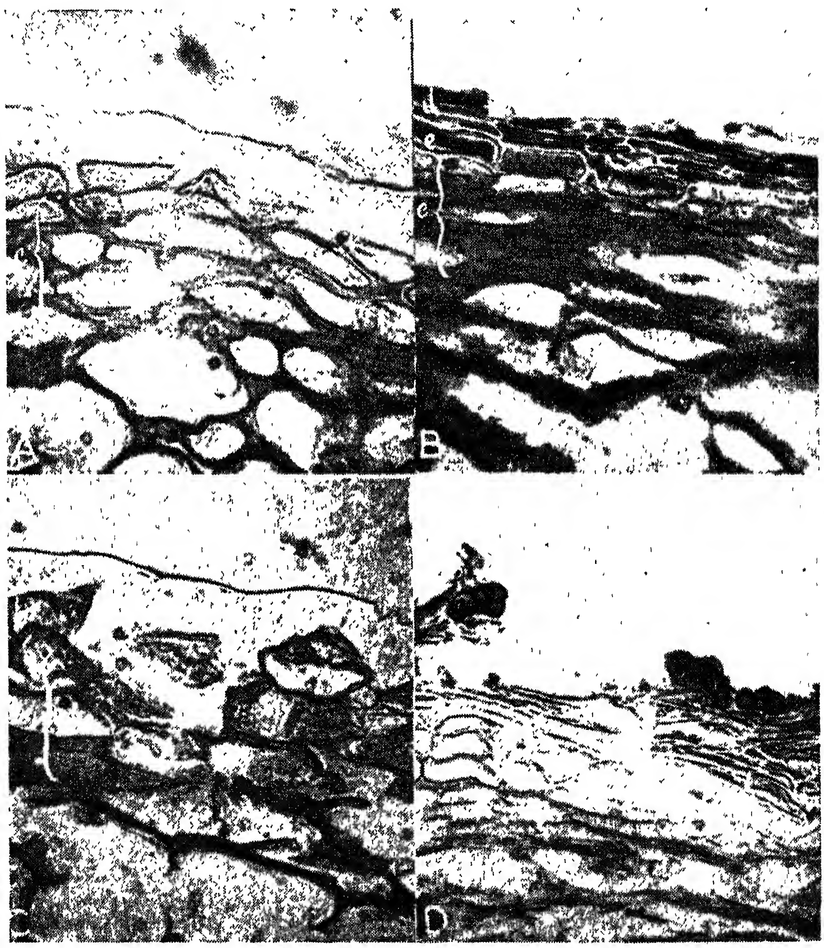

FIG. 2.—Cross-section of apple skin tissue (magnified approximately 450 times): (A) from a well-shaded non-cracking Ohenimuri apple, showing epidermal cells (*b*) drawn apart but covered by a continuous cuticle (*a*), filling the intercellulor spaces, while the hypodermal cells (*c*) more or less retain the form of the underlying pulp cells; (B) from an exposed Ohenimuri apple with russeted skin, showing cork cells (*d*) and cork cambium (*e*), while the cells (*c*) directly underneath the latter are elongated and flattened, indicating a lack of growth extension in the sub-epidermal tissue; (C) from a normal White Winter Pearmain fruit, a non-cracking variety, showing a tissue structure very similar to that of non-cracking Ohenimuri apples, except that the sub-epidermal cells (*c*) are considerably thicker, indicating a high potential elasticity to provide for internal fruit expansion; (D) adjacent to a crack in an Ohenimuri apple, showing dark-coloured fungus cells where the epidermis has been torn away.

same stage of development, which showed little or no russeting, the hypodermal cells appeared to have more or less retained their shape. Noteworthy was that even in apples with a fair degree of russeting, but without cracks, these hypodermal cells did not show any elongation or flattening—a sign of lack of elasticity. In contrast with this, the characteristic flattening of the hypodermal cells could always be noticed in apples with the slightest development of open cracks in the stalk-cavity.

Spraying Tests.

The question as to whether this disease of the Ohenimuri apple is caused by a parasite, was further investigated by means of spraying tests in orchards.

Results of Spraying and Pruning Experiments at Elgin and the Koo, District of Montagu, for the Control of Cracking in Ohenimuri Apples.

Experiment.	Treatment.	Percentage of fruit cracked.	Percentage of fruit badly cracked.	Percentage of russeted fruit.	Average number of of fruit per tree.
Spraying Experiment Elgin 1940/41.	Wetsul..........	68	8	—	53
	Lime-sulphur.....	72	9	—	22
	Verderame.......	86	34	—	21
	Not treated......	81	5	—	46
Spraying Experiment Elgin 1941/42.	Orthol K........	61	16	96	838
	Lime-bentonite...	75	12	95	1,124
	Lime sulphur.....	45	14	97	710
	Not treated......	58	21	96	844
Pruning Experiment Elgin 1941/42.	Severely pruned..	31	12	96	772
	Not pruned......	71	36	99	1,019
Pruning Experiment Elgin 1942/43.	Severely pruned..	42	9	91	253
	Severely pruned for 2nd year..	45	2	95	457
	Only Spurwood severely thinned out...........	54	6	93	358
	Not pruned....	77	20	95	164
Spraying and pruning Experiment The Koo, 1946/47.	Lime-sulphur-sprayed........	49	11	72	214
	Severely pruned..	43	2	73	274
	Not treated......	39	5	69	288
Spraying and pruning Experiment The Koo, 1947/48.	Lime-sulphur-sprayed........	59	1	—	925
	Severely pruned..	44	1	—	397
	Not treated......	41	1	—	827

In the 1940-41 season, lime-sulphur mixture, Wetsul (a wettable sulphur) and Verderame (a copper-oxy-chloride compound) were tested as fungicides against this disease. The first spraying took place when the buds were in the closed-cluster stage and the second, just after the setting of the fruit. For the first spraying, the lime-sulphur mixture was

applied at the rate of 1 gallon to 40 gallons of water, and for the second, at the rate of 1 gallon to 75 gallons of water. Throughout the test, 5 lb. of Wetsul and Verderame were used per 100 gallons of water. In the 1941-42 season three applications of lime-sulphur (1 gallon to 100 gallons of water) were made—the first when most of the petals had dropped, and the others subsequently, at intervals of 8 and 10 days.

As will be seen from the results shown in the accompanying table, not one of these spray treatments brought about a definite decrease in the cracking of the fruit. In the 1941-42 season, the lime-sulphur treatment resulted in a slight improvement, both in respect of the total number of cracked fruit and the number of badly cracked fruit—fruit with deep, open cracks, which had no market value, being classed as badly cracked. The results showed that spraying with lime sulphur had no effect on russeting of the fruit. Spraying with Verderame considerably aggravated the cracking of the fruit.

In experiments conducted in the Koo, District of Montagu, in the 1946-47 and 1947-48 seasons, five applications of lime-sulphur were made according to the following schedule (the figures in brackets indicate the dilutions used for the lime-sulphur mixture):—

Green-bud stage (1-15), closed-cluster stage (1-40), petal-fall stage (1-100), 10 days after petal-fall (1-100), 14 days after the fourth spraying (1-100).

In both seasons this spray schedule aggravated the cracking of fruit in the Koo. The results of these spraying experiments therefore do not support the contention that cracking of the Ohenimuri apple is caused by a fungus and that it can be controlled by spraying.

Apple Cracking: A Functional Disease.

The histological changes which occur in fruit which crack, indicate that the trouble must be associated with functional conditions existing in the tree or fruit itself. In further support of this contention it was also found that the following factors influence the cracking of fruit:—

Seed Content.—There is a direct relation between the seed content and the degree of cracking of the fruit. The most severely cracked specimens usually have a low seed content. Since the seed content is directly influenced by cross-pollination, cracking is always the worst where the Ohenimuri variety is planted alone, and no provision made for cross-pollination.

Size of the Crop.—Growers have often maintained that in years when the trees yield a light crop, the apples are very badly cracked. The crop records of the various experiments furnished no direct proof of the correctness of this theory. It appears, however, that most of the apples which cracked, and especially those which cracked severely, were usually situated singly, those borne in clusters being less severely cracked.

The Position of the Fruit.—Fruit developing in the centre of the tree are less susceptible to russeting and cracking. Such fruit, especially on luxuriantly growing trees, usually have a very fine finish. The majority of the cracked fruits and the most severely russeted specimens are found on the outer branches of the tree and on branches of low vigour.

To determine to what extent shading itself reduced cracking of the fruit, some fruits in exposed positions were enclosed in paper bags while others, in corresponding positions were marked as controls. The results were striking. Of 66 apples enclosed in paper bags, only 32 per cent. cracked, whereas 63 per cent. of the exposed apples were cracked.

Can Cracking of Ohenimuri Apples be Controlled by Cultural Methods?

The results of the foregoing investigations gave rise to the question as to whether it would be possible, through cultural methods, to prevent the occurrence of those physiological disturbances in the fruit which cause cracking. In America, Leif Verner (1940) found, for example, that lime spraying prevents cracking in cherries; Moore (1930), in England, noticed that spraying with oil in summer reduced russeting in the Belle de Boskoop apple.

Oil and Lime Spraying.—During the 1941-42 season, spraying tests were made with lime and with an oil emulsion for apple crack at Elgin. For the lime spraying, a lime-bentonite mixture at the rate of 20 lb. of slaked lime and 10 lb. of bentonite was used to 100 gallons of water, and for the oil spraying a one per cent. mixture of Orthol K,—a light to medium spraying oil. Three applications were made of both sprays: The first just after the setting of the fruit and subsequently at intervals of 8 and 10 days. As shown by the results in the foreging table, the spraying had no effect on russeting and cracking of the fruit.

Pruning Experiments.—The effect of improved tree growth as a result of pruning was also investigated. For two seasons pruning experiments were conducted at Elgin on trees which had not been pruned for a number of years. The terminal branches consequently showed little growth and the trees, in general, had fallen into a state of excessive fruit spur formation and scant leaf development.

In the 1941-42 season a system of very severe pruning was applied to some of these trees, whereby approximately half of the framework and more or less two-thirds of the fruit spurs on the remaining branches were removed. This drastic pruning treatment resulted in a vigorous growth of the trees. The abundant and luxuriant foliage completely shaded the fruit. By the time the fruit was picked the trees were still actively growing. As appears from the results in the table, this treatment and the reaction of the trees noticeably reduced the rate of cracking of the fruit.

In the 1942-43 season the same trees were again submitted to fairly severe pruning. Shoots were thinned out and laterals and spurs topped, but no frame branches were removed. At the same time the system of severe pruning of the previous year was again applied to some of the remaining untreated and neglected trees, while in another treatment, only the fruit spurs were severely pruned.

All the treated trees again showed noticeably improved growth and less cracking of the apples. The effect on the trees of which only the spurs had been removed, was not so marked as in the more severely pruned trees, but was nevertheless clearly noticeable.

Further pruning experiments were conducted in the Koo, District of Montagu, during the 1946-47 and 1947-48 seasons. In this case the experimental trees were in a fairly well-tended condition. They grew well and the fruits were considerably less susceptible to cracking than in the Elgin experiment. In neither season did the system of severe pruning produce the same amount of increased growth as at Elgin and there was no effect noticeable on the cracking of the fruit.

Conclusions.

The contradicting results of the pruning treatments at Elgin and Montagu should in all probability be attributed to the fact that in the

latter instance growth was not a limiting factor and that other factors of the environment played a more important part in the establishment of the conditions in the fruit, which eventually cause cracking.

Lack of Moisture.—The structural changes in the tissues preceding the cracking of the fruit, and the limiting effect of shading on cracking, apparently indicate that apple crack may be associated with excessive loss of moisture from the outer tissues of the fruit, which results in the premature formation of cork in the hypodermal cells. When the cortex of the fruit expands further, the outer tissues, due to lack of elasticity, cannot yield to the internal pressure and the fruit consequently cracks.

The fact that, on trees of equal vigour, apple crack occurs more severely in the drier inland regions than in the humid regions near the coast, seems to support this contention. In Montagu the relative humidity is very low during the summer months, and consequently the loss of water through evaporation and transpiration must be high. It is understandable that a state of physiological drought in the outer tissues of the fruit which leads to cork formation, is more liable to occur under such conditions than in the higher atmospheric humidities of Elgin. It is also possible that fruit of vigorously growing trees is in a condition of such active growth, that the formation of corky tissue and the retarded growth in the outer tissue layers cannot take place, with the result that the fruit are less subject to cracking.

Although improving the vigour of the tree through pruning and other cultural practices, in some cases, is undoubtedly an effective method for reducing the cracking of Ohenimuri apples, there are so many environmental factors which play a part in a functional disease of this nature, that in the circumstances, a single measure, e.g. pruning, cannot have the desired effect. With various conditions of climate, soil and tree growth, different control measures will probably be required. Where a dry atmosphere is the main cause of cracking, measures like the planting of summer cover crops, or the practising of overhead irrigation, may prove valuable for raising the air moisture content. It should, however, be seriously considered whether the Ohenimuri must not be replaced in such regions by other varieties which are better suited to the local climatic conditions.

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Scale Control on Citrus Trees.

Do Oil-Sprays Affect Yield and Quality of Fruit?

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PRIOR to 1933, HCN fumigation had been practised consistently for years in all the citrus-growing areas of the Union, but indications of red-scale resistance to HCN gas in the Kat River Valley of the eastern Cape prompted the use of an oil-spray as a supplementary measure in conjunction with fumigation. But the reported disastrous effects of the oil-sprays on trees, in tests conducted from time to time by commercial firms, required some investigation before general recommendations could be made.

Our incomplete and inaccurate knowledge of the use of oil-sprays and their possible harmful effects on yield and quality of fruit, resulted in the planning and commencing, in 1938, of long-term oil-spray experiments. Operations proceeded simultaneously at two centres in different parts of the country, viz. at Fort Cox in the eastern Cape Province, and at Nelspruit in the eastern Transvaal, representing different climates and soil types.

The orchards consisted of both Navel and Valencia trees, and while all experiments were planned to enable statistical analyses of the data to be made, adaptations as to recplicates, number of trees per plot, etc., had to be made to suit the orchards available. The experiments were continued for seven to eight successive years.

For Cox Expiriments on Navels and Valencias.

These experiments on both varieties of oranges were laid down in orchards at the Fort Cox Native School of Agriculture. The orchards, although not under our control, were given cultural treatment as regards fertilization and irrigation, more or less consistent with accepted practices as applied generally in the area.

At the commencement of the experiment, the trees were about 20 years old, of normal size, fairly uniform in condition and planted in a reddish clayey loam soil.

For both varieties the experimental lay-out was on the complete randomization system with five replications and 8 trees per plot.

The treatments for both Navels and Valencias were—

(*a*) single spray, applied in January each year;
(*b*) single spray applied in April each year;
(*c*) control.

The oil used in these experiments was a heavy-medium oil of 87 per cent. viscosity, unsulphonatable residue value of 97 per cent., and distillation below 636° F.—33 per cent. This oil was applied throughout at a 1½ per cent. concentration.

When applying oil-sprays in both the Fort Cox and Nelspruit experiments, the quantity per tree was not determined beforehand, but the oil was simply applied to effect a practical coverage such as is normally required for scale-control. In picking, the weights as well as the number of fruits were recorded. Fruit samples for quality tests were picked before harvest, the number of fruits per tree being three, picked at random, thus constituting a sample of 24 fruits per plot. These samples were analysed for juice, total soluble solids, acid and sugar-acid ratio.

Since all the data and statistical analyses cannot be given here, only the general results will be discussed. A full report will appear in bulletin form, but details of the data and statistical analyses are in the author's possession and are open for inspection a any time.

Results of Fort Cox Experiments.—The most outstanding effect obtained by heavy-medium oil-sprays in these experiments was the reduction in total solids in the fruit juice of Navels and Valencias; and this reduction was not noticeable for the oil-sprays applied in April. This reduction effect was more pronounced in the case of Navels, since even the January oil-spray application gave a significantly lower percentage total solids than the control.

None of the oil-spray treatments had any effect on the yield, juice, acid and ratio of either Navels or Valencias.

The non-existence of any significant hold-over effects, and the fact that yields, total solids, etc, varied from year to year but did not show any progressive increase or decrease over the whole 8 year period of experimentation, showed conclusively that neither of the oil-spray treatments (on both varieties of citrus) had any cumulative effects.

The Nelspruit Experiments on Navels and Valencias.

For the Nelspruit experiments the procedure and the lay-out were considerably modified so as to include three different times of oil application, and two distinct types (grades) of oil. The lay-out of these experiments on both orange varieties was on the randomized block system with two-tree plots replicated seven times, and the period of experimentation was from 1938 to 1945. These orchards received uniform treatment as regards fertilization and irrigation throughout the experiments. At the commencement of the experiments the trees were 10 years old, in full bearing, of a fairly uniform size, and were planted in a light sandy soil.

The oil emulsions employed in both these experiments were: (1) *Heavy-medium oil,* of the same physical and chemical properties as that used at Fort Cox, and (2) *light oil,* viscosity 59, unsulphonatable residue 85 per cent., distillation below 636° F.—71 per cent.

Both these oils were applied at 2 per cent. concentration for the duration of the experiments, and the number of gallons of oil-spray mixture applied varied from 7 to 14 gallons per tree, the quantity increasing progressively as the trees aged and increased in size.

The picking each year was done in the same week of the same month, i.e., the first week in May for Navels and the first week in September for Valencias. Accurate yield records were kept, and fruit samples for quality tests were taken at random from the field boxes after picking, and consisted of 24 fruits per sample.

The oil-spray treatments for *Navels* were—

(*a*) heavy-medium oil, applied at the end of December;
(*b*) heavy-medium oil, applied in April;
(*c*) heavy-medium oil, applied early in July (after picking);
(*d*) light oil, applied at the end of December;
(*e*) light oil, applied at the end of April;
(*f*) light oil, applied early in July (after picking);
(*g*) control (fumigated).

The oil-spray treatments for *Valencias* were—

(1) heavy-medium oil, applied at the end of December;
(2) heavy-medium oil, applied in April;
(3) heavy-medium oil, applied at the end of December plus light oil in April;

(4) light oil, applied at the end of December;
(5) light oil, applied in April;
(6) light oil, applied at the end of December plus light oil in April;
(7) control (fumigated).

It should be noted that an oil-spray in July (as for Navels) could not be made in the case of Valencias, since the in-season crop was still on the trees at that time.

General Discussion of Results Obtained.

From the results obtained from all these experiments it was found that oil-sprays definitely affect the yield and quality of fruit of Navels and Valencias, and that these effects can be described briefly as follows:—

(*a*) There is some risk during certain seasons that oil-sprays, especially a heavy-medium oil applied at 2 per cent. strength after March, might cause a reduction in yield of both Navels and Valencias. In the case of the former variety a late application of a heavy-medium oil in July (after removal of the crop) significantly reduced the next blossom and the subsequent in-season crop. In the case of the latter variety, a double oil treatment with the second application occurring as late as April also reduced the yield.

(*b*) All oil sprays (as used in these experiments) reduced the total soluble solids of both Navels and Valencias when applied on the in-season crop. Generally speaking, the time of oil-spray application on the in-season crop does not greatly affect the reduction of total solids in sprayed fruit, but in certain seasons (only with a heavy-medium oil), as demonstrated on Navels in both the Fort Cox and the Nelspruit experiments, an April application can cause a significantly greater reduction of total solids than a December application. In the case of Valencias, a double oil treatment (with the second application occurring after March) can cause a considerable reduction of solids in the fruit juice.

Application of a heavy-medium grade oil in July, after removal of the crop, does not affect the solids of the next in-season crop of Navels, but can adversely affect the following season's yield.

(*c*) The acid content of both varieties of citrus is reduced by oil-sprays, and this reduction is more pronounced for a heavy-medium grade oil.

(*d*) A comparatively higher reduction of acid than of total solids, due to oil-sprays, results in a higher sugar-acid ratio for sprayed fruit as compared with unsprayed fruit. It might be assumed therefore, that this higher ratio is a point in favour of oil-sprays, but unfortunately the reduction of total solids alone is of far more importance, in that sprayed fruit may not contain the minimum amount of total solids (9 per cent. for both varieties) as required by government export regulations, although such fruit may pass the ratio standard laid down by these same regulations.

(*e*) Vitamin C content of Navel and Valencia oranges is reduced by oil-sprays, but this reduction is to slight to be of any dietetic or economic importance to the citrus industry.

(*f*) Oil-sprays either reduce or arrest the normal colour development of both Navel and Valencia fruits, and this colour retardation is more pronouced for a heavy-medium grade oil,

and for both grades of oil (used in the Nelspruit experiments), especially when they are applied later than March on the in-season crop. Oil-sprays applied in July, after the Navel crop has been picked, do not affect the colour of the next season's crop.

(*g*) With regard to juice content, rind thickness and size of fruit, oil-sprays did not have any effect on these properties.

(*h*) The non-existence of any significant residual or hold-over effects after seven to eight years of treatment, and the fact that yields, total solids, etc., all varied from year to year, but did not show any progressive increase or decrease for this whole period of experimentation, conclusively showed that none of the oil-spray treatments had any undesirable cumulative effects.

Recommendations.

In making recommendations for the general use of oil-sprays on citrus, the three main issues which are of most economic importance, viz. yield, total soluble solids, and fruit colour, are therefore, constantly to be kept in mind. According to the results obtained from all these experiments, we shall be within the limits of safety when we assume that probably all oils of medium grade and lighter are safe for use as scale-control measures on citrus, provided they are applied fairly early in the season, i.e., during the months of December to March. Normally, oil-sprays should not be applied before the young crop is at least of golf-ball size, as an earlier spray may cause burning and excessive drop of fruit and foliage. As fruit attains golf-ball size during December (depending on locality and blossoming period) it would be safest not to apply oil-sprays much before the end of December. If a heavy-medium grade oil must be used, it should be applied at a weaker concentration and not later than about the end of February, otherwise the colour and solids of the fruit may be reduced.

A light oil which is less likely to affect yield, total solids and fruit colour, may be applied as late as April, but preferably during the first half of the month.

If a double oil treatment should be considered necessary, then two applications of a light oil, or a medium grade oil followed by a light oil applied not later than March, and at least 5 to 8 weeks between the two applications, would be within the limits of safety.

Perhaps the main issue at stake as far as the use of oil-sprays on citrus is concerned, is the danger of reduction of total soluble solids which may necessitate an undue delay in picking the crop in order to allow the fruit to build-up more solids. This delay in picking may sometimes have to be extended for such a long time that fruit (especially Navels) start dropping, before attaining the required minimum amount of total solids in compliance with export regulations.

The non-existence of hold-over effects as a result of oil-spray applications (except when heavy grade oils are applied late in the season), the present-day improved methods of spray-oil manufacture, as well as the fact that spray-oils do not have any undesirable cumulative effects, make their use on citrus comparatively safe, provided the warnings sounded above are taken into consideration.

The recommendations given by Mr. A. J. Smith in his article "The Spraying of Citrus Trees for Scale Control" (*Farming in South Africa*, November, 1943, or Reprint No. 116) are sound, and should be studied in conjunction with this article when accurate information regarding the use of oil-sprays on citrus is desired.

Veld and Pasture Management in the Natal High-rainfall Areas.

J. D. Scott, Senior Professional Officer, Estcourt, Natal.

WITH the emphasis laid on dwindling food resources throughout the world due to soil erosion, with the immense amount of propaganda which has been made to stimulate a demand for soil conservation and with the provision of enormous sums of money in different countries for soil conservation and reclamation purposes, the attention of thinking people has been drawn to three lines of approach to these world problems.

Firstly, there is the problem of arresting the ever accelerating process of erosion and reclaiming land already damaged; secondly, there is the problem of removing the causes of erosion and land deterioration, and, thirdly, there is the problem of producing enough food to feed the people of the world. According to Dr. Bennett about 89 per cent. of the land of the world cannot furnish man with the necessities of life, and some two billion people have to depend for sustenance on four billion acres of land, which is shrinking fast.

The first problem cannot be dealt with here, but our research work is largely bound up with the second and third problems enumerated above. During the past few years we have been faced with food shortage, brought about by various circumstances including drought, accentuated by erosion, and we have to give grave thought to these problems. As we concentrate more and more on them and realize that the soil erosion and land deterioration problems, linked with falling food supplies, are due largely to exploitation of land for production of commodities which are the most paying at the time, we begin to give more attention to the fairly new ideas of correct land use.

Correct Land Use.

By correct land use in agriculture, is meant the use of the land for production of commodities for which it is best suited and which can be continued under sound farming systems to the end of time. It entails the building up of a farm tradition where every farmer is desirous of handing on his farm to his successor in a more productive condition than that in which he found it. This can be done only by planned agriculture in which land-use is governed by our knowledge of climate, soils and vegetation.

It can briefly be stated that the three *main* types of land-use in agriculture are where the land is used (*a*) for *extensive farming*, where the production is largely from the veld, (*b*) *semi-intensive farming*, where the production is largely from the veld, supplemented by production from arable land, and (*c*) *intensive farming*, where the reliance for production is wholly or largely from arable land, with the veld in only a subsidiary rôle.

The big problem is the category into which each farming area falls. Probably more land deteriorations has been caused in South Africa due to intensive farming being applied to areas suitable only for semi-intensive farming or extensive farming than to any other single factor. This has been due to the ignoring of the ecological conditions which should determine land-use areas, i.e. areas with low, badly distributed or erratic rainfall should never be regarded as potential *intensive* land-use areas, as production cannot be relied upon. Similarly, soils which are highly

erodible, with erratic rainfall too, cannot be suitable for intensive farming. In planning our agriculture and particularly our agricultural research, we should do it on lines of correct land-use, based on ecological limiting factors which we cannot control, viz. climate, particularly distribution of rainfall, soil type, vegetation, which is an indicator of the others, and topography.

Only when we have determined the potentially correct land-use, can we really see how our grassland or pasture management fits into the picture. The management of the veld under extensive, semi-intensive and intensive systems will be quite different and, as far as the so-called artificial or planted pastures are concerned, they will play a big part in intensive areas, a small part in the semi-intensive areas and should hardly be worthy of consideration in the extensive areas. This immediately eliminates, in research, a great deal of unnecessary work.

Potential Land-use in Natal.

To those who live in other parts of the Union, Natal is generally regarded as the high-rainfall section of the Union, with a warm climate suitable for production of bananas. Actually it is composed of eight main areas which vary in rainfall from under 20 in. to over 45 in., and summer temperatures of over 100° F. to winter temperatures of below Zero F.

Many will still regard 20 in., when compared with the rest of the Union, as a fairly high rainfall, but the distribution is bad and the area is classed as a low rainfall area.

The accompaying map illustrates the various areas which are characterised by certain veld types. Mr. J. A. Pentz who produced this map of Natal, classified these areas into their various land-use potentialities based on their ecological conditions.* I should like to deal with these areas indicating what their land-use potentialities appear to be and how grassland work fits into the picture.

(1) *Coastal Belt.*—This area has an annual rainfall of over 30 in., well distributed in the summer months with a certain amount in the winter, deep soils and undulating topography. The vegetation is largely coastal bush and evergreen grass. It has all the attributes of a highly intensive area, and has largely developed as such. Up to the present, sugar has been the main commodity produced, but when world sugar production comes back to normal and South Africa is once more on a reduced quota, much land will be thrown out of sugar and will be available for other intensive production.

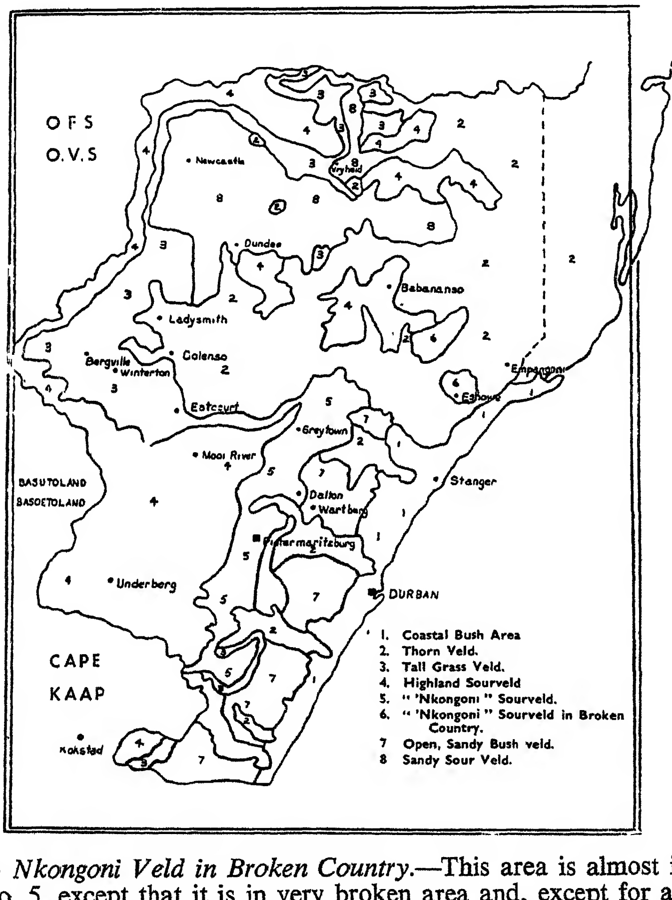
(2) *Dry Thorn or Bush Veld.*—This area has a low erratic rainfall, highly erodible soils, very broken topography, suitable, except where there is irrigation, only for extensive farming.

(3) *Tall Grass Veld of Natal.*—The annual rainfall of this area is in the neighbourhood of 30 in., but it is very badly distributed and very erratic. Hail is a common factor. One year the rainfall may be over 40 in. and the next down to 16 in. The top soil is shallow and the subsoils are very erodible indeed. The topography is open and rolling. This area would appear, at first, to be an ideal intensive area, but the erratic rainfall and erodible subsoils indicate that it is not suitable for anything more than *semi-intensive farming.* This is one of those areas where ecological limiting factors have been ignored and, due to the fact that farming was over-intensified it is one of the few Soil Conservation areas (as opposed to soil conservation districts) in the Union.

* See Bulletin No. 250 " An Agro-Ecological Survey of Natal ", by J. A. Pentz, Division of Soil Conservation & Extension, and obtainable from the Editor, Department of Agriculture, Price 3d.

(4) *The Highland Sourveld.*—This is a large area at a high altitude, with high, well distributed summer rainfall, deep but poor soils, rolling topography. The summers are not very hot but the winters are very cold. This area has all the attributes of an *intensive farming area.* It is viewed as rather a problem area owing to the fact that, with a relatively short summer and bad communications, it was used only for extensive farming which was leading to veld deterioration. With planned land-use as an intensive area it assumes considerable importance from the point of view of production.

(5) *"Nkongoni" Sourveld.*—This area has a high, well distributed rainfall. It is often known as the mistbelt area. It has deep good soils, rolling topography and was probably mostly forest country at one time. It also has all the attributes of a highly *intensive area.*



(6) *Nkongoni Veld in Broken Country.*—This area is almost identical with No. 5, except that it is in very broken area and, except for afforestation, it could not be used for anything but *semi-intensive farming.*

(7) *Open Bush Country.*—This area has an erratic summer rainfall, poorly distryibuted, and sandy soils derived in parts from granite. It is undulating country. Its conditions are suited to *semi-intensive* farming, although the large extent to which erosion can be seen in it, indicates the effect of trying to enforce intensive systems where they do not fit.

(8) *Sandy Sourveld of Northern Natal.*—This area has a variable summer rainfall and very poor shallow badly drained soils. In some parts the country is undulating, but in many it is broken. Owing to its

unpromising ecological conditions it would not appear that this area is suited to anything but *extensive farming.*

Research Objectives and Findings in the Different Areas.

(a) The Coastal Area.

Up to the present there has been no research station interested in agriculture generally in the coast belt. The Sugar Research Station at Mt. Edgecombe has done very good work, but has limited itself to sugar and its problems. At the present time, with a sugar shortage, most land that can grow sugar is being put down to sugar, but it is likely that when conditions come back to normal, a good deal of land will be thrown out of sugar again. At the same time, it would appear that the main zone of sugar production is slowly moving northwards which will leave much potentially intensive farming land for other types of intensive production. What these lines of intensive production will be, requires much attention.

Agricultural Pursuits.

Pig production is assuming importance on the north coast. While there will always be a big demand for dairy products. Fruit, vegetables, and poultry products also will be in demand and can be produced. Crops such as groundnuts and fibre crops, may also be of importance. There is the fact, however, that soil fertility will have to be maintained and there is every reason to believe that established pastures will play a big part in the future development of the coastal areas, both from the point of view of animal production and of maintenance of soil fertility.

A. certain amount of work has already been done with various grasses, both at the Doornkop and Kearsney Sugar Estates. Records from the latter estates show that some grasses, planted on old cane land which had been thrown out of production because they were the poorest, thrived remarkably well and had a high carrying capacity. A few figures, worked out on a grazing-day basis, are most interesting, particularly when it is borne in mind that these lands were regarded as poor lands and no fertilizers were applied to the grasses at all.

Grass.	Date Planted or sown.	Cattle Grazing days per acre.			
		1.7.43 to 30.6.44.	1.7.44 to 30.6.45.	1.7.45 to 30.6.46.	1.7.46 to 31.12.46. (6 months) only.
Rhodes Grass	23.2.43	180	235	497	131
Star grass	23.6.43	97	363	385	119
Star grass	13.9.44	—	164	493	252
Digitaria Wynberg Str.	16.6.44	—	133	521	200

These are amongst the more promising strains, but, when a carrying capacity ranging from 2 acres per beast to less than 1 acre per beast is obtained from old lands without fertilizer, the future for cultivated pastures fitting into a system of intensive farming, looks most promising.

Research.

The research work that is required, however, will have to cover a large field. Firstly, there is the question of a farming system and how pasture management will fit into that system. Then there is the search,

not only for suitable grasses, but for grasses for special purposes—permanent pastures and pastures which are used for leys, grasses which will provide better grazing at some seasons than other, and grasses which will give the greatest amount of high-quality conserved feed. The length of time for which a grass should be used in a ley will have to be determined, while fertilizer practice will also demand much work. In addition, the management of cultivated pastures, particularly those used in leys require highly skilled management and, to-day, in this country, this is an aspect of grassland work that has been hardly touched. It will be seen therefore that the scope for fundamental research work in a scheme of planned land-use is enormous.

(b) The Tall Grassveld Area.

This area would probably be classified amongst the high-rainfall areas, in comparison with most of the Union, but its land-use potentiality is only for semi-intensive farming. It has largely been intensified for crop and milk production, with dire results, owing to the erodibility of crop land. It is maintained that this area should be beef producing, with milk, crops, pigs, etc., as side lines. The amount of arable land which can be maintained in fertility is a limiting factor here. The big problems from the grassland aspect here are: (*a*) veld management, in which is included veld burning, (*b*) conservation of feed from the veld, and (*c*) the use of grasses in leys to maintain soil fertility. A great deal of work has been done on veld management, and veld burning, and the conservation of feed from the veld. Results have been applied on a fair scale and, with the growing out of beef, it has been found possible to carry one beast per five acres and market the steers from the veld without additional feed at an average age of 2½ years, at dressed weights ranging from 500 lb., to well over 600 lb. with always more than 60 per cent. primes.

So far, owing to lack of suitable land for experimentation, it has not been possible to carry out work on grass leys, but it is hoped that this will be possible in the near future. In conjunction with this, work is necessary on milk production as a side-line to beef, and on the value of the veld in milk production.

Fundamental work has been carried out on veld burning, cutting of grass at different stages, conserving of cut grass for hay, and management of veld. There is still much scope when land is available for work on cultivated pastures, particularly for grass leys. It has to be established which grasses are most suitable for this purpose, at which period they will give best grazing, the length of the ley and the rotation into which it should fit. Further, the building up of soil fertility to carry a pasture which will restore soil structure, and the management of the pastures need special attention.

(c) The Highland Sourveld.

This is potentially an intensive farming area. Until recently it was used for only a few months in the year, but with closer settlement and better communications, its possibilities for intensive farming have been realized. Here work has been done on production from the veld—it is probably the highest producing veld in the Union—but production from arable land in the form of crops and pastures should be even greater. The main problem is soil fertility.

A big programme of research work is being undertaken in this area on soil fertility, the production of crops and pastures and the part to be played by pastures in crop rotation, as well as the balance between crops, pastures and veld.

In this area high production from pastures is possible if the soil fertility is there, and much work on composting, feeding of stock on the land (particularly pigs), green manuring, and grass leys has been planned. The type of grass for the ley, the length of ley, its management and fertilizing, the depth and types of cultivation, all require a great deal of fundamental work, and on the results of such work it will be possible to build a system of balanced farming.

(d) The "Nkongoni" Sourveld.

This should possibly be the most intensive area in Natal, as has so often been stressed by Dr. Fisher. Much work has been done at Cedara on cultivated pastures, mainly kikuyu and paspalum, and valuable results have been obtained on the production of milk from pastures. This should be a premier dairying area, and there is much scope for work on crop production with pastures in a rotation. Very little work has been done on the veld here. While it is realized that the veld, in such an intensive area, is, or should be, entirely subsidiary, the fact still remains that quite a fair percentage of the land is not suitable for arable land, and the management of such veld for dry, young or working animals is of importance.

In addition to work on the fundamental principles of management, burning and cutting of veld, there is still much fundamental work to be done on cultivated grasses. Much valuable work has been done on types of grasses and clovers and their fertilizing and management, but much is required on their effects on soil structure and fertility, and the length of ley.

(e) Nkongoni Veld in Broken Country.

In these areas, veld management will prove of importance, but so far no work has been done at all.

Here the main objectives would be to develop a balanced system of farming in which the reliance on arable land is much reduced. This immediately focuses attention on management of what veld is left and the re-establishment of a useful type of grass cover on old lands or lands which should be thrown out of cultivation. The work should be directed, firstly, towards finding grasses which will grow on the depleted land and give some return. The problems of raising soil fertility to the stage at which the land will carry better grasses, the types of grasses, the period at which they are of most value, their management and fertilizer treatment are fundamental. The development of proper crop rotations with grass to restore structure has been preached, but no work has been done in this connection, and the field is open.

(f) Sandy Sour Veld.

The sandy sourveld of Northern Natal, is another of the problem areas of Natal. With its poor, badly drained soils, except in a few pockets, and its badly distributed rainfall, it is not suitable for anything but extensive farming. Large areas have been ruined by intensive farming, while other areas have been badly damaged by a bad system of extensive farming, viz. sheep farming. This is due to the fact that the sheep farmer in sourveld has made autumn burning—an exceedingly bad practice in itself without the addition of the grazing animal—a standard practice, and he maintains he cannot farm sheep without it. If this is so, the sooner the system is changed, the better, as that country will not carry sheep much longer. There is no evidence as yet that it will not be possible

to carry sheep in this area if numbers are greatly reduced and cattle are greatly increased. This area is in great need of research, but there is as yet no research station in it.

Had fundamental research work been carried out in this area, it would have been possible to lay down principles of land management which would have obviated a great deal of the damage which has already been done. A great deal of work is needed on veld burning, veld management and conservation of feed from the veld to fit local conditions. Principles on all these problems have still to be established, and once these principles have been determined, it will be possible to attack the problems of sheep-cattle ratio's and the correct system of farming for this area.

Application of Basic Principles.

This then, is a picture of farming potentialities in most of the main veld types and climatic regions of Natal, as well as a brief description of the fundamental problems which face the grassland worker. The need for fundamental research has been stressed because it is that research which gives us the basic principles on which all other work must be built. As far as grazing management is concerned, we have established certain principles which were unknown in this country ten years ago, and, with a knowledge of those principles, it is possible to apply systems of management to meet the needs of many areas. Similarly, we have established certain basic principles regarding veld burning and veld reclamation in certain areas. The stressing of these principles has been made possible because we first tackled our problems on the basis of correct land-use. There are other parts of the country with high rainfall —the eastern O.F.S., eastern Transvaal and the eastern Cape Province. These will have similar problems which require solution and, if correct land-use, based on ecological conditions, is taken as a basis for tackling the problems, agriculture can be put on a sound and permanent footing. This applies also to the areas of lower rainfall, and what is needed is a uniform basis or conception for determining land-use. Ecological conditions in these areas must be the real basis, as described for Natal. The tendency in the past has been to follow the farmer. Where wrong land-use has been the order of the day—due to markets or other economic conditions—research has been directed at assisting him to continue on the lines he has followed. If we are to conserve our soils and produce the necessary food, we have to think and plan ahead, and planning of land-use is essential.

Food Production.

In my introductory remarks and again later the question of food production was mentioned. I have tried to show how planned land-use can ensure soil conservation and serve as a basis for research. It will also serve as the basis in a policy for the production of food. In the past the tendency has been to concentrate on research and talk about production of food from areas of lower rainfall where drought is always a feature. The soil fertility is there, but *production is unreliable because we cannot control the rainfall.*

In the high rainfall areas, production depends on our ability to build soil fertility—which can be done. Surely then the focal point of increased production should be in the high rainfall areas.

When grassland research was initiated, a number of stations were opened in areas of high rainfall which were then regarded as problem areas. These stations have not only shown that these areas are not the

problem areas they were supposed to be, but that they have the natural potentialities for high production, because they have the ecologial conditions which, with the land-use planning applied, make this production possible.

A simile that appealed to me recently was that when in warfare, a unit ran into trouble, it was not necessarily reinforced because there was no use in throwing good lives away to retrive an error, but, when there was a break-through, every reserve was pushed in to give a victory. I think this applies in our campaign for food to feed the world. Our opportunity of break-through is in the high-rainfall areas where ecological conditions are not weighted against us, but where we can use what there is for increased production. I am not talking against research in the low rainfall areas—that would be foolish—but I feel that research in those areas is aimed at reclamation and building up what has deteriorated; in other words, holding the desert at bay. I do stress, however, that the possibilities of enhanced food production and of carrying a greatly increased population is in the high rainfall areas. To attain this end, a big programme of research with the necessary staff is required, and it is required soon if we are to survive as an European entity in South Africa.

Control of Household Insects.

This Bulletin, No. 192 (third edition), has been revised and a new chapter on D.D.T. and Gammexane Insecticides has been added. Price 6d. per copy. Obtainable from the Editor of Publications, Pretoria.

Fruit Production in the Union.

Bulletin No. 281 (Report No. 29) has been issued by the Division of Horticulture from the office of the Chief Fruit Inspector, Cape Town, and contains statistical information of the citrus fruit exports for the 1946 season.

A summary of citrus exports during the war years is also given.

The information given in the bulletin is as follows:—

1. Monthly shipments of citrus during the seasons 1940 to 1945.
2. Shipments of citrus from the various ports. Seasons 1940 to 1945.
3. The total seasonal citrus exports. Seasons 1911 to 1946.
4. Varieties of citrus exported during the 1946 season.
5. The quantity of citrus exported from each locality during the 1946 season.
6. The duration of the 1946 citrus export season for the chief varieties in the various provinces.
7. Monthly shipments of citrus from the various ports, 1946.
8. Quantity of citrus rejected at the various ports during the 1946 season, with reasons for rejections.

This Bulletin is obtainable from the above-mentioned address at 3d. per copy, post free.

Animal Husbandry in the Eastern High-rainfall Area.

E. K. Hall, Senior Professional Officer, College of Agriculture, Cedara.

IN this country, farming has not always been in that close harmony with its natural environment which is so essential to success. On the contrary, little cognisance has, at times, been taken of the all-important factors such as climate, rainfall, soil, topography, and so forth. Disregarding these important factors, there has been a tendency to jump from one enterprise to another—a practice motivated by the personal factor, expediency, market fluctuations, etc., rather than sound farming systems We have many examples of this in both livestock and crops. Attempts have been made to go in for dairy farming in totally unsuitable environments; sheep have been run under conditions quite unsuited for this purpose. Similarly, high prices have induced farmers to attempt the growing of crops where the chances of success are very slight. Farming maladjustments are all too common, and must inevitably lead to failure.

A first essential of efficient production is that producers should develop and concentrate on farming systems suited to their environment, with due regard to market requirements. Just as the mariner depends on his instruments for navigation purposes, so the farmer must be guided by agro-ecological and agro-economic surveys, otherwise inefficient farming, which is so commonplace and widespread in the Union, will continue and, no doubt, increase.

Planning of Farming Systems.

A step in the right direction was taken recently when a conference of Officers of the Division of Soil Conservation and Extension was held at Bloemfontein to discuss suitable farming systems for that Province—an action worthy of emulation by other Provinces.

Many different types of farming are to be found in Natal, such as ranching, dairy farming, steer fattening, sheep, pigs, poultry horse-breeding sugar, wattles, timber, maize, potatoes, fruit, market gardening, flowers, etc., or combinations of several of these. While there is a tendency for farmers to adopt a similar type of farming in areas where basic conditions are the same, yet more than one type of farming may be practised in the same area. There may be sound reasons for this, but on the other hand personal preference or custom may affect the type of farming.

As is to be expected, many cases of maladjustment are in evidence. Cheek by jowl one will find dairy cattle and beef-cattle farming in an area admirably suited to dairying, or *vice versa*.

The Province of Natal represents only 7·5 per cent. of the total area of the Union, yet it carries 22 per cent. of the total cattle population, 15 per cent. of the pigs, and 14 per cent. of the poultry, in addition to all the other livestock.

As far as dairy cattle are concerned, Natal, in January 1947, had more cows on official test than any of the other Provinces, the figures being:

Natal, 32·5 per cent.; Cape, 32 per cent.; Transvaal, 20 per cent.; and O.F.S., 15·5 per cent.

The above figures indicate that certain areas of Natal are well suited to intensive agriculture. Parts of the midlands of Natal, for example, possess vast productive potentialities, as yet unrealized, but capable of

realization. Such areas, if efficiently utilized, are capable of producing a large amount of the Union's food requirements, in certain products. The dairy cow, the sow and the hen are destined to play a very important rôle in the development and intensification of these areas, where they must dominate, and become the major enterprise. In suitable areas, yields of 2,000 gallons of milk per acre are feasible on high-quality, fertilized pasture, properly managed. In such areas, livestock, such as beef cattle, can play only a minor rôle.

Density of Livestock. Population per Square Mile.

Class.	Cape.	Natal.	Transvaal.	O.F.S.	Total.
Cattle	13·8	75·8	31·2	42·2	25·5
Pigs	1·6	3·4	2·6	2·4	2·0
Poultry	12·5	37·5	29·5	41·4	21·3
Horses	1·2	2·5	1·3	4·3	1·6
Mules	0·33	0·35	0·21	0·17	0·28
Donkeys	1·3	3·1	2·9	1·6	1·8
Sheep (Wool)	70·2	47·9	30·0	152·7	67·8
Sheep (other)	16·9	7·6	6·7	13·0	13·4
Goats (Angora)	2·4	0·2	0·02	0·63	1·5
Goats (Other)	12·1	31·7	8·3	0·78	11·5

Owing to the topography of the land, not all high-rainfall areas are suitable for intensive farming, and these can best be utilized for beef cattle and/or afforestation purposes. Other high-rainfall areas are suited only to semi-intensive farming, since the rainfall is bady distributed.

The coastal belt, in addition to being primarily an important sugar producing area, produces a large variety of fruit, and within recent years has become an important pig-producing area. Members of the North Coast Pig Breeders' Association are marketing from 50 to 100 baconers per week.

It is anticipated that considerable areas of land which are to-day producing sugar, will be converted into small holdings and residential sites during the next few decades. A great deal of this area is potentially suited to intensive farming, with dairy cattle and pigs, fruit, etc., and pastures can be established which will provide grazing for practically the entire year.

Any attempt to predict the future is fraught with danger. Henry Ford once said " The future has always cared for itself in spite of our well-meant efforts to hamper it. " Nevertheless, in this age of scientific progress and transition, one must anticipate developments which may have a bearing on, if not a threat to agriculture. A recent report stated that a synthetic leather, made from soyabeans, walnut shells, and saw dust, had been produced, and that already 75 million pairs of soles had been made. If this product can oust leather to any extent, the wattle industry which to-day has 500,000 acres under trees may be affected, in which case part of this acreage, at least, would be released for other purposes, and since this is a high-rainfall area, intensive farming would be the logical succession, depending on topography, etc.

Research in Animal Husbandry.

Very little research has thus far been carried out in Natal, and there is a vast amount to be done, not only in connection with livestock, but also with cognate subjects.

The interdependence between livestock, on the one hand, and grass and arable crops, on the other, is well recognised, and the nexus binding them together is a strong one. It follows, therefore, that if livestock production is to be made more efficient, the same must apply to all associated

subjects, such as crops and grass, since these products and livestock are complementary.

There are many agricultural problems waiting for investigation. Many of these are of a general character, others are more applicable to specific areas, and will depend on the systems of farming recommended for defined areas.

Within recent years we have seen a transition from the free marketing system to one of price stability for certain agricultural products, both livestock and crops—in some cases seasonal fixed prices, or fixed maximum prices. In view of these facts, certain investigations, involving aspects, are essential.

Pigs.

(1) *Pig Testing.*—No appreciable improvement in the standard of our pigs can be expected until pig testing comes into operation. In this connection S.A. is lagging behind other countries, since nothing has, as yet, materialised in this matter.

For many years dairy farmers in the Union have had the opportunity of entering their herds of dairy cows under the official milk-recording schemes. Similarly egg-laying competitions have been run for poultry breeders. But pig-testing, which is the counterpart of milk-recording in cattle, or egg-laying competitions in poultry, has not yet made its appearance.

If productive efficiency is to be stepped up, and this is very necessary, then pig-testing must be started with as little delay as possible.

(2) *Self-feeding of Pigs.*—In view of increasing labour difficulties on farms, the future will most likely see an extension in the use of these labour-saving devices. Data are therefore required in regard to the use of self-feeders, particularly in the feeding of slaughter pigs.

(3) *Soft-fat Investigations.*—Since soyabeans and peanuts are playing an ever increasing rôle in our agriculture, these feeds will, no doubt, be used more extensively than heretofore in the rations of pigs. Information is required regarding the quantities of these feeds which can be used in the pig's ration, with maize as the basal ingredient, without having an adverse effect on the carcase.

(4) *Molasses in the Pig's Rations.*—In the coastal area, green feed is the only part of the ration which is not purchased. Since molasses is available at a relatively low cost, there is likely to be an extension of its use in this area in pig feeding, as a partial substitute for maize.

(5) *Pasture* vs. *Soiling.*—Information is required on this subject, particularly in so far as slaughter pigs are concerned.

(6) *The Maximum and Optimum Percentage of Fibre in the Pig's Ration.*—If pigs are able to utilize more fibre in their rations, less concentrates will be required.

(7) *The Minimum Percentage of Animal Protein in the Pig's Rations.*—In view of the scarcity of animal protein, data are required on this point.

(8) *The Minimum Percentage of Total Protein in the Pig's Ration.*—Protein is generally the most expensive item in the ration, hence the desirability of having this information.

(9) *Breeds and Crosses.*—(i) Are the existing breeds the most suitable for our conditions, or should others be investigated? (ii) Is cross-breeding essential for the production of porkers and baconers? (iii) Does the crossbred excel both pure-bred parents?

(10) *Costs of Production for.*—(i) Weaners, (ii) porkers, and (iii) baconers. Information regarding costs of production is essential, since

such costs are the rocks upon which the pig industry must, ultimately, succeed or founder.

Apropos of the question of costs, the report of the National Marketing Council on the Marketing Board says: "There has been an evident scarcity of costing data for price-fixing purposes. It is imperative that the costing of farm enterprises should be done more frequently".

"Pig production could be expanded almost indefinitely, but would depend upon future pork and bacon prices in relation to the cost of feedstuffs, particularly of cereals. A considerable expansion on the production of pigs will, no doubt, occur, should the production of beef and especially mutton in future fail to keep pace with the growth in the urban population, and in its purchasing power.

Moreover, since any appreciable future expansion in beef production would have to be based largely on a more intensive use of feedstuffs, the competitive position of the pig industry in relation to cattle should be improved.

The S.A. Agricultural Union Executive Committee, on 3rd June, 1947, expressed its regret that there are still agricultural products controlled by the commodity boards under the Marketing Act for which no accurate production cost survey has been made and that, consequently, prices for those products must be fixed arbitrarily."

At a recent meeting of the Pig Development Association of S.A. the Chairman said: "Bacon and ham should not be a luxury food in reach of only a few. All should be able to buy it. To lower the cost to the consumer, the pig farmer would have to use the greatest efficiency in his methods."

Dairy Cattle.

Sir John Orr, Director-General of F.A.O., stated recently that the world was still faced with a 3-4 year food shortage. A report of the Special Meeting on Urgent Food Problems, issued by F.A.O., recommended—

(1) the maximum diversion of grain from animals to human consumption;

(2) the maximum use of pasture, hay, straw, and other bulky fodder and waste products;

(3) that the feeding of grain to pigs and poultry be reduced to a minimum.

A great deal of information is required regarding the feeding of dairy cattle. In view of the world shortage of grains, and in order to obtain information essential to the feeding of dairy cows economically, work involving the greater use of roughage in the rations of dairy cows is indicated:—

(1) What level of production can be obtained on a ration of roughage only: (*a*) veld or pasture, plus mixed hay as a supplement, and (*b*) succulent feed (silage) and mixed hay—in winter.

(2) Silage as the sole roughage, *vs.* (*a*) hay only, and (*b*) hay and silage.

(3) The influence of feeds, or feed deficiencies, on the composition of milk, e.g. fertilized pasture *vs.* unfertilized.

Research in New Zealand indicates that a low level of nutrition depresses the S.N.F. content of milk; and further that the S.N.F. content declines during abnormally hot weather.

(4) Farm produced high-protein supplement (soyabean seed) *vs.* oil cake.

(5) In view of the serious shortage of minerals, other sources should be investigated, e.g. de-fluorinated rock phosphate.

(6) *Hay and Silage.*—The old adage says, "Make hay while the sun shines". However good this advice may be, its application is very frequently impossible in high-rainfall areas. Climatic conditions are at times unsuited to haymaking under field conditions, in areas where 80 per cent. or more of the rainfall comes between October and March.

The question arises, should not greater importance be attached to silage making and less to hay in such areas?

From a livestock point of view, an important problem for investigation is the comparative efficiency of ensiling, barn-curing and field-curing of grass and forage crops.

In work carried out in the U.S.A., 86 per cent. of the original protein was retained in silage, compared with 74 per cent. in barn-cured hay, and 68 per cent. in field curing. Moreover, the carotene content of the silage was infinitely higher in the silage than in the hay.

By utilizing the crop in the form of silage rather than hay, 12½ per cent. more milk per acre was obtained, which represents an appreciable increase.

(7) *Artificially Dried Grass.*—What data are available on this subject? Should the feasibility of grass drying not be investigated?

The difficulty of curing hay plants at their most nutritious stage of growth, without excessive loss, and the problem of maintaining their high nutritional value during handling and storage, are matters of great importance to livestock farmers, since they are so closely associated with the well-being of the stock, and, in addition, to the cost of feeding.

(8) The relative efficiency of milk production by cows of varying potentialities, e.g. 1 gallon, 2 gallon, 3 gallon, etc.

(9) Cost of milk production in different producing areas during (*a*) summer, and (*b*) winter.

The standard of efficiency in dairy farming is, generally, very low, and accordingly production costs tend to be unduly high. Research is needed to probe into the factors responsible for these shortcomings, with a view to bringing about greater efficiency and lower costs.

The consumer is the all important factor in the prosperity of the dairy business, and the way to increase the demand for dairy products is to make them available at a reasonable price, so that consumers will use the maximum quantities. High prices, on the other hand, mean that minimum quantities, or substitutes, are used.

The report of the National Marketing Council (1946) gives the following data in regard to butter-fat prices in the Union and some other countries:—

Year.	Union.	New Zealand.	Australia.	U.S.A.
	(d. per lb.)	(d. per lb.)	(d. per lb.)	d. per lb.)
1936–37	11·3	10·8	—	16·1
1937–38	14·1	11·9	—	12·8
1938–39	13·3	12·9	13·1	12·6
1944·45	23·4	15·8	18·7	30·1
1945–56	26·7	16·6	19·0	30·1

According to the above figures, the prices paid to the producer in S.A. compare very favourably with those in other countries.

The vast majority of owners of milk cows in S.A. are quite ignorant of the yields of their cows. Only an occasional one has any conception of the actual production of individual cows.

Dairy farming in S.A. is still largely in the "pace of the ox" era. The number of recorded cows in the Union is pitifully small, and represents about 0·5 per cent. of the total number classed as dairy cows. In New Zealand, where the total number of milk cows is approximately the same as in the Union, there are over 300,000 cows on test, or about 15 per cent.

The attainment of a higher level of productivity, and of lower production costs is of vital significance to the welfare of the dairy cattle industry in S.A.

(10) *Milking Machines.*—There is a great deal of interest in milking machines to-day, and in view of labour difficulties on farms, there is every possibility that their use will be extended greatly in the Union within the near future. Hence problems connected with mechanised milking should be investigated, such as: (*a*) Mechanical—different makes, efficiency, etc., (*b*) physiological, and (*c*) costs.

Other Breeding Problems.

Artificial Insemination.—Not only breed societies, but also private breeders are intensely interested in this subject.

The most important development in recent years for improving the producing ability of dairy cattle has been the use of artificial insemination in order to breed large numbers of cows to outstanding sires.

Research is needed into the various aspects of this subject, especially in regard to its possibilities in (i) commercial herds; and (ii) pedigree herds.

Sire Surveys.—As far as dairy cattle are concerned, sire surveys should be undertaken in order to locate desirable inheritance.

The use of more progeny-tested sires would be invaluable to the dairy-cattle industry.

Calf Rearing.—The following are some of the points on which data are required: (*a*) Minimum and optimum quantities of milk, (*b*) milk substitutes, and (*c*) costs of rearing.

Beef Cattle.—Some of the problems for investigation are: (i) Cost of production of weaners, (ii) cost of fattening steers, (iii) relative economy of fattening steers of different ages, and (iv) methods of fattening, e.g. (*a*) roughage only (hay and succulent feed), (*b*) succulent feed and concentrates, (*c*) hay and concentrates, and (*d*) molasses as a partial substitute for maize.

Power on the Farm.—A problem which arises more particularly in the intensive and semi-intensive areas is that of power for the numerous farm operations. Is this to be equine, ox, or tractor?

At present little or no data are available regarding the relative efficiency, cost, etc., of the different power units.

If heavy equines are likely to be the main source of draught power, then problems involving the nutrition, etc. of these animals should be tackled. An economic study of animal and mechanical power is indicated.

Conclusion.

In outlining this programme, little or no attempt has been made to earmark problems for particular zones, because livestock, in general, show a greater degree of flexibility in their adaptability to their environment than do plants. For example, breeds of cattle and pigs that do well in the sugar belt, are found scattered throughout the Union, under a great variety of conditions. Yet one could hardly visualize many plants thriving outside their somewhat circumscribed natural environment.

Most of the problems mentioned are of particular interest and application to the semi-intensive and intensive areas.

[Continued on page 624.

The Biological Control of the Karoo Caterpillar.

Dr. Bernard Smit, Principal Entomologist, Pretoria.

THE Karoo caterpillar is one of the most serious pests in the wool-growing areas of South Africa, and is peculiar as a pest in that it is an idigenous insect feeding on its natural food plant. Insects are not usually pests under such circumstances. In this case, however, the balance of Nature has been so upset by the sheep that the caterpillars become extremely abundant and the sweet Karoo bush (*Pentzia*) is often eaten off until there is nothing left for the sheep to feed on.

Because of the vast areas of veld that are affected, it is quite out of the question to use insecticides, and the catching of the moths in light traps or the application of any other mechanical method is impractical because of the enormous numbers of the insects that develop.

Biological Control.

The only possible control method that can be used in this case is therefore the biological one. By this we mean the use of parasites which are set free in the veld to attack the Karoo caterpillar.

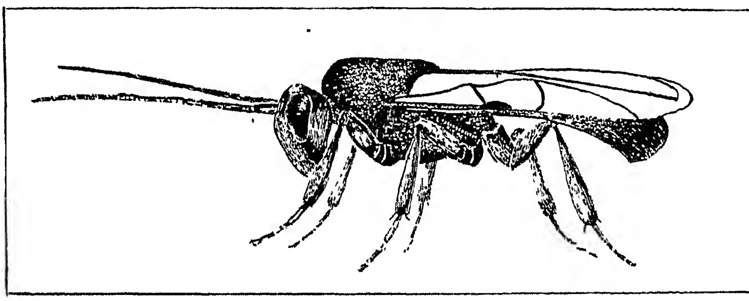


FIG. 1.—The Chelonus wasp. Natural Posture. (Greatly Enlarged.)

The natural parasites that are already attacking the pest in the Karoo are obviously not very effective, and we must look for others which can be introduced with better prospects of success. In America there is a caterpillar called the Beetwebworm which belongs to the same genus (*Loxostege*) as our Karoo caterpillar, and there is also a very efficient parasite called *Chelonus texanus* which helps to keep the Beetwebworm under control. This Chelonus parasite is a small wasp which is not very specific and will attack several different species of caterpillars, including, the cutworm, the bollworm and also the common meal moth, *Ephestia*. The parasite has now been introduced into South Africa from America and we have it at the Sunnyside Parasite Laboratory in Pretoria. In order to carry out the method of biological control with it, it is necessary to breed it in large numbers and distribute it widely where the Karoo caterpillar pest is abundant.

The Chelonus wasp is about $\frac{3}{8}$ of an inch long and dark-brown in colour, looking rather like a small ant with wings. It is an active insect and searches for the eggs of the Karoo moth which it attacks by stinging them and laying its own tiny eggs in them. The eggs of the Karoo moth then hatch normally into Karoo caterpillars and these feed and grow on the bushes as if nothing had happened to them. Inside their bodies, however,

is the larva of the parasite which hatched from the parasite egg which was laid inside the egg of the Karoo moth. The parasite larva develops slowly at first and allows the host caterpillar to grow almost to maturity. The larva then completes its development using up all the inside of the caterpillar for its food and emerges as a new adult Chelonus wasp.

It is important to remember that the Chelonus must have Karoo moth eggs in which to lay its own eggs and breed. It will not attack the Karoo caterpillars themselves, like the large hunting wasps or hornets (*Perdebye*) attack caterpillars in our gardens. It does however, destroy its host, because in the end a new Chelonus emerges from the Karoo moth pupa instead of a moth.

When we liberate the parasites in the veld, we must, therefore do this when there is an abudance of moth eggs on the bushes, and this occurs from five to ten days after the moths have emerged from the soil. Farmers in the Karoo learn when to expect the appearance of the moths after summer rains.

Distribution of Parasites.

The parasites are sent out from the Sunnyside Laboratory in specially made boxes with well ventilated lids that are screwed on tightly so as to prevent the small wasps from escaping en route. In the lower part of the box is fastened a metal container which holds about a gallon of water, and before being sent off this water is frozen into a solid block of ice. This is to keep the parasites cool and more or less inactive on the journey. For food, they are given split raisins pinned onto the sides of the box and they are also provided with a pad of wet cotton wool to provide drink and moisture.

When releasing the parasites in the veld, a sheltered place should be chosen where there is some dampness and low-growing dense bush for the parasites to shelter in, usually near a windmill or dam. Do not liberate them where there are ants about, because these will attack and destroy the parasites. Open the box carefully and put the lid upside down on a bush so that those on the inside of the lid can fly away. Leave the box in the sun to warm up for a while, so that those in it will become active and fly up into the bushes. It may be better to carry the box from place to place so as to distribute the wasps over a wider area. Usually we put 3000 parasites in a box and these can be distributed over about a morgen of veld.

When most of the parasites have crawled out or flow away, the rest can be blown out of the box. There are usually some that get lodged under the raisins or around the damp pad and a good blow with the mouth will dislodge these. Do not throw them out onto the ground if this can be avoided. Be sure that all the insects are out before replacing the lid and returning the box to Pretoria, and please report to the Laboratory in what condition you found the parasites. Accidents happen in the best regulated families and it has sometimes happened that they escaped or got killed on the way down to the Karoo.

Rearing of Chelonus Parasites.

Although the Karoo caterpillar becomes so abundant in the veld, it is a difficult insect to rear in captivity and it would be very difficult to breed up large numbers of the Chelonus wasp in it under artificial conditions. Advantage has therefore been taken of the fact that Chelonus breeds in the meal moth and this is being used as the host insect for mass breeding in the laboratory. A brief account of the method will be interesting and will also show the reader how involved and highly technical such work is. The method was developed by Dr. G. C. Ullyett who was, until recently, in charge of the Sunnyside Parasite Laboratory in Pretoria.

The meal moth is a common pest in mills and pantries but when it has to be reared in large numbers in pure cultures and under strictly sanitary conditions, the problem is not as easy as it may seem. First of all a number of moths are placed in a tin which has wire gauze soldered over its two open ends. The tin is then placed in a shallow tray containing a mixture of flour and talc, and the moths are thereby induced to lay their eggs through the gauze in this flour mixture. With the meal moth the proportions of male to female moths are about equal, and in order to get the maximum number of eggs, the correct number of female moths must be used for the size of tin and the quantity of flour made available. After the eggs have been laid the flour-talc mixture is sifted in a special electric sieve to recover the eggs which are weighed and the number then calculated. About 43,500 eggs weigh one gram. The flour-talc mixture can be used over and over again to get more eggs from the moths. The meal moth eggs are then stuck in batches, on strips of white

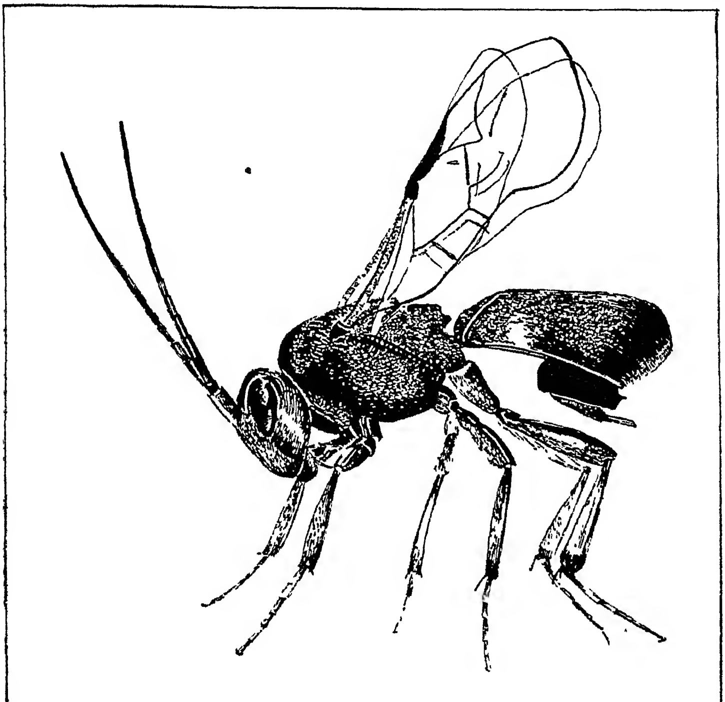


FIG. 2.—The Chelonus wasp in action. (Greatly Enlarged.)

card in the following manner:— A stiff card about 8 by 5 inches is coated with gum and over this is placed a thin sheet of tin in which there are rows of small holes each about ¼ inch in diameter. The eggs are then sprinkled over this tin-plate with a salt shaker so that about 100 fall through each hole and stick to the card. The rest are shaken off and used later for another card. When the gum has dried the card is cut into strips so that there are 10 egg masses to each strip giving a total of 1000 moth eggs per strip.

For the actual rearing of moths or parasites, a standard flat wooden box is used which is twelve inches square and two inches deep with a sliding glass lid. About a pound of coarse unsifted wheaten meal is put into this box and if a pure culture of meal moth is to be obtained, three of the egg strips are placed on the surface of the meal.

If Chelonus is to be reared the strips of card with the moth eggs on them are first exposed for a day to the female parasites which have first been mated with males in a separate box. One hundred females of Chelonus are put with six egg strips in one box for oviposition, and the strips are then put on the meal, three to each rearing box as described for rearing moths. The boxes for rearing moths and parasites are kept in special rearing rooms at a temperature of 80° F. and after about five weeks the moths and parasites begin to emerge. In the moth boxes are, of course no Chelonus parasites, but in the parasite boxes there are always some moths as well as the wasps because all the moth eggs do not become parasitised during oviposition. In a good batch about 90 percent will emerge as Chelonus and only 10 persent as moths.

The moths and parasites are then sorted out and counted by an ingenious suction method whereby they are drawn with air through tubes into different glass containers. Moths that are not required for further breeding are destroyed, but the parasites are put into spesial boxes with tins of frozen water and sent to the Karoo for distribution. In collecting the parasites from the breeding boxes, great care has to be taken not to injure them. At the Sunnyside Laboratory a special suction plant has been installed and vacuum is laid on in all the breeding rooms. The suction is adjusted carefully by means of taps for each kind of insect so as to lift it into its container without injuring it.

Many difficultis have been encountered and overcome in this work, as for instance the attack of ants, the breeding of flour beetles in the meal and latterly a protozoan disease called Mettesia, which has attacked the meal moth larva. In spite of these difficulties nearly two million Chelonus parasites were reared during the 1947-48 season and the insect has been widely distributed in the Karoo. It may be several years, however, before it becomes acclimatised and begins to show results in bringing the Karoo caterpillar under control.

It will be seen from the above that the rearing and distrtibution of such a parasite as Chelonus requires much basic research of a very technical nature and that to do this work, one must have specialised scientific equipment and a highly trained staff. If however, the work is succesful, the benefits to the country will be permanent and will far outweigh all the time and money that has been spent on it.

Animal Husbandry in the Eastern High-rainfall Area.

[*Continued from page* 620.

While it is realized that the programme submitted is rather a formidable and ambitious one, yet it should also be borne in mind that a great deal of leeway has to be made up, and the need for information arising from such investigations is clear.

In agriculture the rate of progress is directly proportional to the sum total of background information available. So data gleaned from such research, when disseminated among the livestock-farming community, should help materially in raising the productivity of our livestock— a consummation devoutly to be wished and striven for.

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Grenadilla Production.

E. F. Malan, Sub-Tropical Horticultural Research Station, Nelspruit.

AS a result of the keen demand for grenadillas during the past few years, not only for use as fresh fruit but also for the manufacture of cool drinks, grenadilla production has developed into a profitable industry. To what extent the present high price levels will be maintained depends mainly upon the supply and demand. According to present indications, prospects are promising, especially if the production season could be extended over a longer period. The most popular variety to-day is the so-called "Common Purple" (*Passiflora edulis*).

Climate.

In the production of grenadillas, climate plays an important rôle, and only areas with a relatively high humidity and which are more or less free from frost, are suitable for the commercial cultivation of this crop. Under ideal soil and climatic conditions two crops are obtained per annum. An altitude of approximately 3,000 feet above sea level appears to be most suitable.

Although the planting season is to a certain extent determined by climatic conditions, the seed could be planted at any time of the year. For most areas, however, early spring is regarded as the most suitable time. The seed is sown sparsely in seedbeds and the seedlings are transplanted as soon as they are ready, i.e. after 7 or 8 weeks. The seed is taken from healthy ripe fruit, typical of the variety, and planted immediately.

Preparation of the Soil.

Inurement is necessary before the seedlings are transplanted. To this end the cheese cloth or canvas which serves as protection should be removed early and gradually (i.e. about a week before transplanting). Hardiness can also be induced in the seedlings by limiting irrigation of the seedbeds to a minimum. A thorough watering is necessary on the day preceding transplanting.

Since the grenadilla is a perennial crop, with an economic life of from 4 to 6 years, the soil should be thoroughly prepared beforehand. A good method of preparation is to plough under a green manure, such as sunn hemp or velvet beans, which had been sown with 5 to 10 tons of kraal manure and 600 lb. of superphosphate per morgen.

Most soils, *if well-drained*, are suitable for the crop. Deep, cool loam or sandy loam soils, however, produce the heaviest crops. A few shovelfuls of compost or well-rotted kraal manure and 2 lb. of rock phosphate may be mixed with the topsoil in the bottom of the planting holes (2½ by 2½ by 2 ft.). Durng the first year, the colour of the leaves and the vigour of the plants will serve as an indication of any deficiency. In the event of a yellow discolouration as the result of a nitrogenous deficiency or virus infection, a top dressing of ammonium sulphate or other nitrogenous fertilizer may be applied. An excessive application of nitrogen may, however, promote growth at the expense of bearing capacity.

An annual application of ½ to 1 lb. superphosphate and of 15 to 20 lb. of kraal manure per plant should be sufficient to maintain the yielding capacity of the plants.

Apart from the fact that the grenadilla plants have shallow root systems, the aereal and subterranean development of this plant is extensive and consequently much space is required. Thus, the rows should be at least from 8 to 12 feet and the plants in the row from 18 to 24 feet apart. Greater yields are often obtained with an eastern slope and the rows running from north to south. Approximately 450 seedlings are required for one morgen, with a planting space of 10 by 20 ft.

Training and Pruning.

In view of the enormous development of luxuriant grenadilla plants, it is essential that they be trained on firmly erected trellises. One No 12 steel strand about 5½ to 7 feet above the ground should be sufficiently strong to bear the weight of the plants and fruit. The strand is strained taut across the tops of the treated wooden poles which should be firmly planted, supported and anchored and which may be from 15 to 20 feet apart. As the plants develop, the lateral shoots are removed from the main stem and the latter trained along a temporary pole or the permanent poles as far as the wire, from where the shoots are trained in both directions.

The yielding capacity of grenadillas is closely associated with the space allotted to the plants. For this reason a system of two horizontal strands attached to a "T" piece at the top of the pole is often preferred.

Although grenadillas are fairly resistant to drought, the water requirements of the plants are relatively high and irrigation facilities cannot therefore be altogether left out of account. The laying of terraces on sloping soil will facilitate irrigation and reduce soil erosion.

The rejuvenation of old plants by cutting them low down or at ground-level, is not recommended. Better results are obtained by an annual judicious thinning out of superfluous shoots during winter.

On the whole, grenadillas have up to the present seldom been attacked by insects or diseases. Recently, however, a *virus disease* has been observed, characterized by yellowing and curling of the leaves and the development on the fruit of hard, woody swellings which later crack. It is not yet known what control measures could be effectively applied, and it is recommended that any plants showing the above-mentioned symptoms during the first or second year should be carefully removed and destroyed.

Crop yields vary according to climatic conditions, age, treatment, etc. We can, however, accept, as a conservative estimate, that one grenadilla plant should yield an average of at least 1½ pockets of fruit annually. The maximum yield is reached during the second year, after which the yields gradually decrease.

Veld Management in S.A.

Bulletin No. 278 „Veld Management in South Afrika" by J. D. Scott has recently been published.

Copies of this Bulletin are obtainable from the Editor of Publications, Pretoria, at 3d. per copy.

Should Lead Arsenate be Used in Codling Moth Control?

Dr. W. A. K. Stubbings, Western Province Fruit Research Station, Stellenbosch.

DURING the war and early post-war period great developments have taken place in the production of synthetic organic compounds, several of which have been found to possess outstanding insecticidal properties. The best known of these compounds is D.D.T., which has proved to be particularly effective against the codling moth. D.D.T. is rapidly replacing lead arsenate in most fruitgrowing countries for use against this insect, and the time has arrived to decide whether it is advisable to dispense entirely with lead arsenate for codling moth control.

Acid lead arsenate was first used as an insecticide towards the end of last century. It is relatively cheap, but there are a number of serious objections to its use on pear and apple trees, such as comparative lack of effectiveness, toxicity to plant growth, and danger to human health.

Lack of Effectiveness.

Lead arsenate has been used intensively for coddling moth control at the Cape for a period of over thirty years, and the insect appears to have developed a high degree of resistance to arsenic. General experience and experimental work shows that many of the newly hatched larvae are able to establish themselves in fruit that has been sprayed heavily and well with lead arsenate. It is also a slow-acting stomach poison, and is unable to prevent superficial damage by a high percentage of larvae that bore through the skin of the fruit and subsequently die. Such blemishes are popularly known as "stings", and greatly decrease the market value of the fruit. It is clear from the above that the effectiveness of lead arsenate against the codling moth leaves much to be desired.

Toxicity to Plant Growth.

Foliage injury often results from the use of lead arsenate, particularly in the case of the apple. The injury is frequently of a severe order, and can cause total defoliation of the trees in early summer. Such premature defoliation not only reduces the size of the fruit on affected trees during the same season, but seriously limits the reserve materials, built up by the leaves, which are essential to future growth and production. It has been found that premature defoliation can result in a crop reduction of at least 50 persent or more during the following season, and will reduce the vigour of the trees. The poor condition of apple trees in some of the main applegrowing areas of the western Cape about ten years ago is largely due to spray programmes of lead. arsenate, which was used exclusively on this fruit up to 1939.

Spray damage often results from the use of lead arsenate and lime sulphur combination sprays applied in spring against the codling moth and fusicladium, owing to chemical reaction between these materials in the spray tank which results in the production of a considerable amount of water-soluble arsenic. Thus the application of even one spray of lead arsenate at the calyx stage is not considered advisable. D.D.T. can be used in conjunction with lime sulphur at this stage with more safety and effectiveness.

Danger to Human Health.

Possibly the greatest limitation possessed by lead arsenate is its high toxicity to humans and other warm-blooded animals. This has led to drastic legislation against poisonous spray residues on fruit; apples and pears carrying arsenical spray residues in excess of 0·1 gns (1/100 of a grain) arsenious oxide per lb. cannot be exported to Britain, while the legal tolerance for the Union has been fixed at 0·02 gns (1/50 of a grain) or just double the export tolerance.

Where no special measures are taken to remove arsenical residues from the fruit after picking, fruit which has received only two lead arsenate sprays at the commencement of the spray programme may be rejected for export. Growers are loth to carry out the standard removal practice of washing the fruit in dilute hydrochloric acid, as this process is detrimental to the keeping quality of the fruit.

Although codling moth control was very successful during the past season, and very few rejections of pears for arsenical residues were made in the western Cape Province, the experience of another applegrowing area, the Longkloof, is not as fortunate. In this area many growers applied three or more sprays of lead arsenate and omitted to carry out removal methods. More than 30 per cent. of pears packed for export in this area were rejected for excessive arsenical residue.

The marketing of apples carrying arsenical loads in excess of the legal tolerance in the Union has received much publicity during recent months. This has been due to the flagrant neglect of a very small percentage of growers, who have sent fruit to market carrying dangerously heavy lead-arsenate residues. Municipal and Government Health Inspectors are fully aware of the position, and it is likely that the regulations will be very strictly enforced during the coming season. It would be very shortsighted and foolish therefore, not to take a realistic attitude in the matter.

Summary.

An attempt has been made in the foregoing to point out the limitations of lead arsenate as an insecticide for codling moth control. The time has now arrived for lead arsenate to be excluded from the codling moth spray programme.

Cheap and effective spray programmes of D.D.T. are now available that possess none of the disadvantages bound up with the use of lead arsenate. Special articles have been written on the subject which will be made available to all farmers through the Deciduous Fruit Board and on application to the Director, Western Province Fruit Research Station, Stellenbosch.

Spray Programme for Pears and Apples:—

[*Continued from page* 588.

case of pears. This mite is protected by the web it spins (generally on the underside of leaves and in the calyx end of the fruit) and very thorough application of sprays is necessary for effective control.

When infestation has reached a level of about 3 to 4 mites per leaf, it is desirable to apply two sprays of DN-111 or Dynone at the dosages mentioned above and at an interval of about 10 days.

One of these two sprays could conveniently be combined with the nearest codling moth spray.

Chicken-Pox.*

J. D. W. A. Coles, Onderstepoort.

CHICKEN-POX is a contagious disease that occurs not only all over the Union but all over the world. It is the cause of heavy losses.

An Important Point.

An important point to be emphasized is that chicken-pox is not the same as roup (infectious coryza). Only in very recent years has this fact been realized. Roup never shows scabs on the comb, wattles or skin, and the chicken-pox vaccine will not immunize against it. Owing to past confusion, these two distinct diseases have been known by various names such as cold, catarrh, roup, diphtheria, diphtheritic roup, canker, swollen head and swollen eye.

It is true that some cases of chicken-pox show the lesions of roup only, but some fowls in the flock are almost certain to show the typical pustules and scabs on the comb, etc., if the disease is really chicken-pox.

The Cause.

Chicken-pox is due to a very small organism which can be seen distinctly only with the best microscopes. The organism enters a body cell and there multiplies to form a "colony" of hundreds of the organisms, actually within the cell. The organisms can be stained by special methods and can now be grown away from the fowl, particularly in developing chicken embryos.

Occurrence of the Disease.

Fowl-pox may occur throughout the year, but usually is at its worst from September to March. Cases in early spring usually occur in young chickens, whereas those in January to April are confined mainly to pullets bitten on the comb by mosquitoes shortly after the birds come into production.

The disease is essentially one of young birds, but even old hens may be affected. A recovered bird is usually immune for life.

Apart from the transmission by mosquitoes and blood-sucking flies, the organisms can enter susceptible fowls through small lesions in the mouth or through small wounds in the skin, due to fighting, etc.

Turkeys are very susceptible to ckicken-pox. Pigeons sometimes contact the disease, but usually suffer from pigeon-pox, which is caused by another variety of the organism. Anything that lowers the vitality of a fowl makes it more susceptible to chicken-pox. Such conditions are bad hygiene, exposure to cold, wet weather, infestation with lice, red mite, tampans and worms, and bad feeding. If white instead of yellow maize is fed, and green feed is scarce, chicken-pox will be more dangerous.

Symptoms.

These are well known. Most people have seen the small whitish yellow pustules that develop later into the brown wart-like growths on the comb and wattles. There may be discharge from the nostrils, little

* The STRONG FOWL-POX VACCINE is used exclusively on healthy fowls and turkeys 1 to 3 months old.

whitish spots in the mouth, swollen and closed-up eyes, and even the common condition known as the "pip", which is a hardening of the tip of the tongue due to the fowl breathing through the mouth. If the nose is open, a fowl will not develop the "pip". Cases have been described where fowls showed only a little nasal discharge, but were ill and got "light" and finally died.

As in roup, a fowl may die of suffocation due to the entrance to the windpipe being blocked by a bit of yellowish diphtheritic material.

In odd cases the wart-like growths, following pustules, may be seen on the skin almost all over the body, especially the legs.

A solitary lesion on a fowl is sufficient to upset egg production for 3 or 4 weeks. Hence, a mild outbreak may cause considerable financial loss, even though no birds die.

Treatment.

When the lesions are confined to the comb and skin, it is probably best not to treat them at all, for no drugs act specifically on the germs, and rubbing on medicines often leads only to a spread of the infection. If the eyes and mouth are badly affected, or if the skin shows extensive lesions, it is far better to kill the bird. Occasional white particles in the mouth can be removed and the sore patches then painted with tincture of iodine or mercurochrome, and, if the eyes are not badly affected, they can be washed out twice daily with a warm boracic acid solution. People treating sick birds should wash their hands thoroughly in running water before handling healthy ones. It is best to isolate sick birds. Fowl-pox organisms can survive in the soil for a few weeks and can be carried on the hands, clothing and shoes of people coming into contact with cases of the disease.

Preventive Measures.

(*a*) Always be on the look-out for cases of chicken-pox, and do not hesitate to kill and burn badly diseased birds, unless the number affected is so large that the owner feels he must attempt to treat them.

(*b*) Correct defects in the hygiene.

(*c*) Feed properly, and supply a sufficiency of vitamin A which occurs in green feed and yellow maize. Sour skim-milk helps to build body vigour.

(*d*) Control internal and external parasites, including mosquitoes.

(*e*) Provide pure uncontaminated water.

(*f*) Isolate for at least two weeks all newly-purchased fowls and turkeys, and those returning from shows and competitions.

(*g*) Vaccinate regularly; this is the most important measure and usually has to be carried out only once during the lifetime of a bird.

Immunization.

If chickens are vaccinated *when* 1 *to* 3 *months old* and when in good health and being well fed, etc., they should not suffer from the process. Rarely, however, they show temporary retardation of growth, but the experience is that such chickens are indistinguishable from the others by the time they are four to five months old. If the fowls are inoculated when over three months old, they may "go light" and not lay well. Contrary to popular belief, there is no evidence to suggest that

annual inoculation leads to the establishment of chicken-pox on a farm. When all susceptible birds are inoculated more or less at the same time, the infection seems to die out soon.

Chicken-pox vaccine is issued in glass bottles, and should be used not later than 7 days after receipt. Do not expose it to direct sunlight. Shake the bottle very well before use, breaking up any sediment.

Pull the cork out and stick one end of the thick, short, double-pointed needle into the cork, the idea being to afford protection to the index finger when stabbing the skin of the bird. Disinfectants must on no account be used on the fowl's skin. Only very seldom is it necessary to wash and dry the skin before vaccination.

Instruct an assistant to hold the bird to be vaccinated, on its side with the feet towards the operator. Grasp the upper foot and pull the leg out straight. With the fingers of the left hand, part the feathers on the outside of the thigh. Dip the point of the needle into the vaccine, place the right index finger on the cork attached to the other end of the needle, and pierce the skin *once* to a depth of one-eighth of an inch. Make sure that the skin has indeed been punctured. Only one puncture must be made and consequently this way of vaccination is known as the single-stab method. As soon as the skin has been pierced once, the bird is released. It is easy to vaccinate 200 birds an hour. Always be sure that a thick film of vaccine covers the end of the needle before stabbing the skin.

A reacting bird shows a small firm swelling on the skin, up to about 4 mm. in diameter, at the inoculation site, within 5 or more days. Usually no constitutional symptoms are noted. The skin reaction is over by about the twelfth day. Unless 95 per cent. of the birds show skin reactions by the eighth or ninth day, the non-reactors should be revaccinated.

Vaccination will not cure, but only prevent chicken-pox, and cannot be expected to help much if most of the fowls in a flock are affected, since it takes at least 14 days for immunity to develop.

The price of the vaccine is 2s. 6d. for sufficient material to vaccinate 100 chickens. Vaccine is obtainable in 100-dose bottles from the Officer-in-Charge, Allerton Laboratory, P.O. Box 405, Pietermaritzburg, Natal, or from the Onderstepoort Laboratory, P.O. Onderstepoort, Transvaal.

Although every care is taken in the preparation of the vaccine, the Department accepts no responsibility for any ill-effects which may occur as a result of its use.

If it is necessary to vaccinate birds younger than a month or older than 3 months, or birds of 1 to 3 months that are not in very good condition, the WEAKER VACCINE should be bought. This also is issued only in 100-dose bottles costing 2s. 6d.

IMPORTANT NOTICE.

Will persons who place orders for vaccines please note that:—

(*a*) No refund of the purchase price or credit will be made if purchasers return the vaccine to the Department.

(*b*) Such returned vaccine will always be destroyed.

Ask for Price List of Laboratory Products and note the correct addresses.

Diseases of Calves.

Coccidiosis (Red Diarrhoea).

Dr. M. W. Henning, Professor of Veterinary Science, Agricultural Research Institute, Pretoria.

IN an article on calf paratyphoid*, which is one of the most serious diseases in calves in South Africa, I pointed out how stock owners are sometimes inclined, without sufficient evidence, to attribute all their losses in calves to paratyphoid when the cause may actually be some other disease, such as heartwater, gallsickness, redwater, coccidiosis, calf-pneumonia or calf diphtheria.

During the past year or two, more and more losses in calves have been brought to our notice where neither paratyphoid nor any of the tick-borne diseases could be incriminated. When paratyphoid vaccine was used in these cases, it was found to be of no avail. In a number of these outbreaks coccidiosis proved to be the cause of the mortality. It has, therefore, been considered advisable to give a detailed description of this disease.

Nature of Disease.

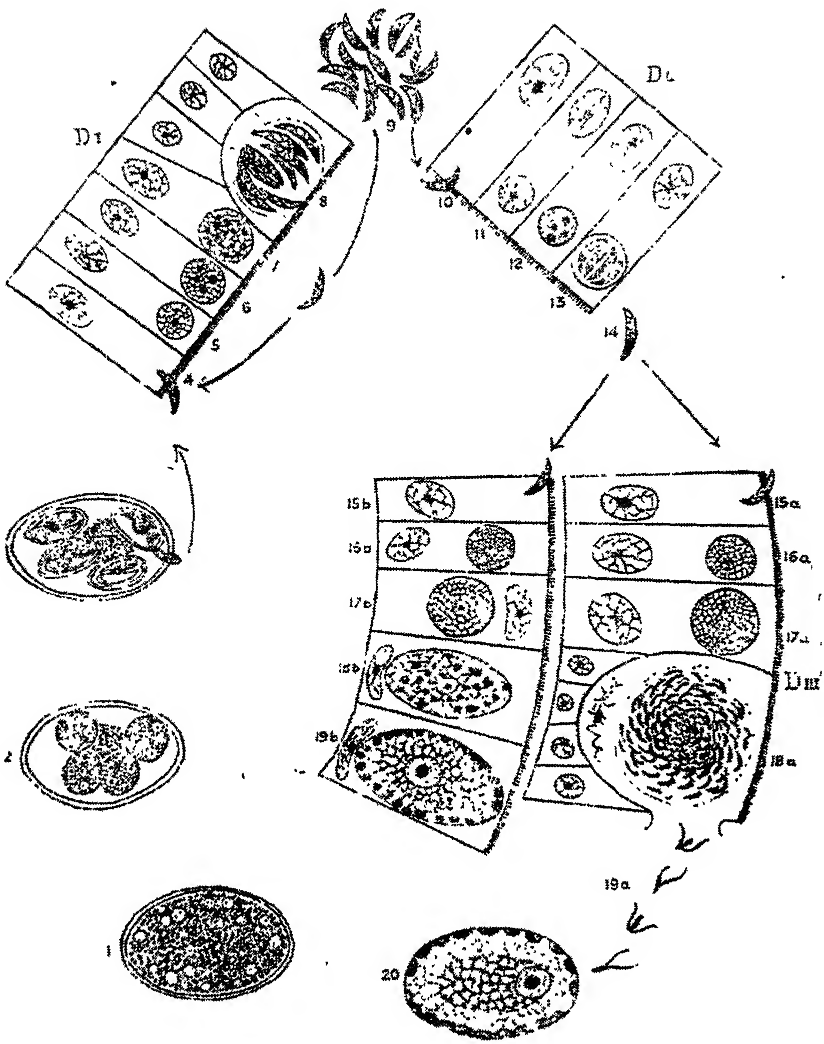
Coccidioses is an infectious disease of cattle caused by a parasite, the coccidium, which invades the digestive tract, mainly the large intestine. It affects mostly young bovines and gives rise to bloody evacuations.

A number of species have been incriminated, but the most common cause of bovine coccidiosis is a coccidium known as *Eimeria zürnii,* named after the Swiss Veterinarian, Zürn, who was the first to describe this disease in cattle.

The Life Cycle.

Coccidia are generally eliminated as oöcysts (1) with the faeces from the body of the host. These oöcysts are small, round or oval cells with a very thick and resistant wall (see illustration). They are about 3 or 4 times the diameter of a red blood cell. When the oöcyst arrives in a favourable environment, it undergoes a process of ripening or spore formation (sporulation). Inside its thick wall, four sporoblasts (2, 3) are formed and each sporoblast gives rise to two banana-shaped sporozoites (3, 4), i.e. each sporulated oöcyst contains 8 sporozoites. Infection of the host occurs when food and water, contaminated with sporulated oöcyst (2, 3), is ingested by the host. In the intestine the sporozoites are liberated from the oöcyst. They move about freely and penetrate into the ephithelial cells of the intestinal mucous membrane (4). In these cells the merozoites grow into round bodies (the schizonts, 7, 8). The schizont divides and gives rise to a number of banana-shaped merozoites (8, 9). The invaded ephithelial cells rupture and liberate a number of merzoites (9), which again move about in the intenstine and invade new epithelial cells (10). They again form round schizonts (11, 12, 13), which give rise to more merozoites. This is known as the asexual cycle of multiplication (DI, DII), which may be repeated for a certain number of generations, until finally a generation of merozoites is formed which develops into cells known as gametocytes. These gametocytes are the precursors of male

* See *Farming in S.A.*, September, 1941.



D. IN THE INTESTINE OF HOST.—(1) Oöcyst before sporulation (inside intestine of host and in faeces when excreted); (2) mature or sporulated oöcyst with 4 sporoblasts, outside the host; (3) liberation of sporozoites when the oöcyst reaches the intestine of the host. Each Oöcyst contains altogether 8 of these banana-shaped sporozoites; (4) penetration of epithelial cell of the intestine by the sporozoite; (5) to (8) development of parasite in the cells of the intestinal wall. Asexual development DI, DII; (8) a schizont with a number of merozoites before rupture of the cell; (9) the merosoites are liberated to penetrate new epithelial cells; (10) to (13) repetition of the asexual development which occurs within 5 to 8 days; (14) a merozoite which either repeats the asexual development in (10) to (13), or changes into a precursor of the male or female gametocyte. In this way the sexual development (gametogenesis, D. III) appears; (15b) to (19 b) development of female gametocyte in the epithelial cells of the intestinal wall; (15 a to 19 a) development of male gametocyte; (18 b) to (20) the female macrogametocyte matures and becomes encysted. It now develops into an oöcyst which leaves the epithelial cell to lie free in the intestine, where it is fertilized by the male gametocyte; (18 a) a number of male microgametocytes develop and are liberated in the intestine (19 a). Each male cell has two flagella and swims about in the intestine until it meets a female macrogametocyte with which it fuses to form a zygote (fertilized oöcyst). A hard, thick wall forms around the fertilized oöcyst. The oöcyst (1) is now ready to be excreted in the faeces where it sporulates or ripens under favourable conditions (1, 2,3); (19 a) ripe male gametocytes with two flagella which swim about freely in the intestine in search of a female gametocyte with which to fuse (20). (According to Becker, 1934.)

and female cells. The male gametocyte divides and forms a number of free-swimming male cells (15a-19a), whereas the female gametocyte enlarges and forms a wall to envelop it. At one end of the wall there is a small pore. Thorough this pore a male cell enters to fuse with the female cell (20) and forms a fertilized cell or zygote. After a thick wall has formed around the fertilized cell it becomes the oöcyst. The oöcyst is evacuated with the faeces, but it is not infective immediately. Under suitable conditons of temperature and moisture it develops into a sporulated or ripe oöcyst. Inside each oöcyst, four sporoblasts, each containing two sporozoites, develop before the ripe or infective stage (the sporulated oöcyst) is reached.

Environmental Factors.

For sporulation or ripening, the oöcyst requires a certain time, which is determined by favourable physical and chemical conditions. Extremes of temperature are unfavourable. In very cold and very hot surroundings, the oöcyst will not sporulate. When heated to over 50° C., all the oöcysts will perish. Desiccation and sunlight are detrimental, but moisture and moderate heat are essential for their development. A moist, dirty stable floor, contaminated with infected faeces, is therefore a very favourable environment for the development of oöcysts; air or oxygen is also beneficial. Under optimal conditions of heat and moisture, the infective stage may be reached in 2 or 3 days, but under less favourable conditions sporulation will not take place unless at least 2 or 3 weeks have elapsed. Under natural conditions the infective stage is usually reached about 1 to 2 weeks after the oöcysts have been evacuated by the host.

Provided there is sufficient moisture, sporulation (ripening) will proceed very rapidly between 25 to 30° C., but it will be very slow if the temperature falls below 15° C. If kept in a moist medium at a temperature above -2°C. and below 37°C. the oöcysts will survive for at least a year, provided they are not exposed to the action of bacteria.

Putrefaction of the surrounding medium is detrimental to the survival of the oöcysts, and bacterial growth may be regarded as the most important factor responsible for their natural destruction. The heat which is evolved during the fermentation of a compost or of a manure heap is so high (up to 60° C.) that very few oöcysts present in the manure will escape destruction.

But the oöcysts are remarkably resistant to many chemicals which are highly bacteriocidal, e.g., the oöcysts will withstand exposure to 0·1 per cent. potassium permanganate, 0·1 per cent. corrosive sublimate, 5 per cent. formalin, 5 per cent. phenol, 5 per cent. copper sulphate. The use of chemical disinfectants for the destruction of oöcysts in contaminated quarters, therefore, is of very little avail as a rule.

Transmission.

Recovered animals are immune, but they owe their immunity to the retention of the parasite in their bodies. They remain carriers and spread the disease by constantly discharging small numbers of oöcysts with the faeces. They are, therefore, an important source of infection. But oöcysts may also be passed in small numbers by apparently healthy animals, in both infected and healthy herds. In 1941 an eight-months' old Friesland heifer at the University Farm suddenly developed an acute attack of red diarrhoea. On examining the bloody discharge, large numbers of oöcysts were found. This was the first case of coccidiosis recorded on this farm.

With a view to preventing gross contamination of the University Farm, the animal was removed to Onderstepoort, where it could be kept under observation. It was placed in a clean loose box and it made an uneventful recovery in a week or two without any treatment. Four other Friesland heifers that had been running under identical conditions with the affected one, never developed clinical symptoms of coccidiosis; but an examination of the faeces showed that every one was discharging oöcysts in small numbers.

It appears that natural infection usually occurs as a result of a single massive infection or of the continuous ingestion of small numbers of sporulated oöcysts. There is probably some unknown predisposing factor which favours infection under natural conditions. When this factor is not operating, infection does not take place. This is probably the reason why it is sometimes difficult to set up a severe infection experimentally, even by employing massive doses of oöcysts.

Susceptibility.

Coccidiosis generally appears in its most virulent form in very young animals. Older animals are usually less susceptible as they have often acquired a certain amount of immunity at an earlier age.

In some outbreaks infection may occur soon after birth, and blood may appear in the faeces in 3 to 6 weeks' time, but clinical symptoms are seldom noticed before the calf is 2 to 3 months old. It is frequently the strongest, healthiest and the most robust calf that suffers first. If the disease has once made its appearance, it may spread very rapidly and affect a number of calves in a short time, unless suitable measures are promptly taken. It is most remarkable, however, that if a group of animals are exposed to the same conditions, only a certain number will develop clinical symptoms of coccidiosis, the others remaining apparently healthy; but should the faeces of the latter be examined, the presence of a variable number of oöcysts will generally be revealed.

Although young animals usually suffer the worst from coccidiosis, adults may sometimes also be badly affected. The writer has seen several very severe and fatal cases of coccidiosis in adult cattle pastured on the heaths in parts of Cornwall, England.

Coccidiosis has frequently been reported in store cattle brought in from the veld to be fattened in a pen or enclosure. The hygienic conditions under which these animals are kept, frequently leave a great deal to be desired, and it may be possible that the environment is favourable for the operation of those unknown predisposing factors already mentioned.

Symptoms.

The incubation is commonly believed to be about 3 weeks, but occasionally it may be barely a week, or it may be as long as 1 or 2 months in animals transferred from the stable to infected veld.

As stated above, it is the healthiest, strongest and most robust calves that first become affected. The severity of the symptoms may vary in different cases, but the predominant symptom is always diarrhoea. As the disease progresses, scouring becomes more and more severe until the evacuations are thin, watery and bloody. The discharge is evacuated under great strain and may contain fluid blood, blood clots, mucus and shreds of epithelium that have peeled off. After a few days the evacuations become foetid, greenish black, with more shreds of ephithelium and

dots of blood. The straining becomes more and more severe and painful, sometimes leading to prolapse of the anus. The animal is forced into a characteristic posture with its back arched, its abdomen tucked up, its legs drawn together, its coat staring and its head held low; it becomes dull and listless and grinds its teeth intermittently; its eyes are deeply sunken and saliva dribbles from its mouth.

At first the appetite is fair, but as the disease progresses there may be no inclination to eat. The animal loses condition rapidly and as a result of the marked loss of blood it becomes weak and anaemic. Finally it dies from extreme weakness and exhaustion.

Sometimes there is no haemorrhage and no blood in the faeces, yet the animal loses condition and becomes weak and debilitated.

Oöcysts are always found in large numbers in the faeces during the acute stage. When improvement sets in fewer and fewer oöcysts are evacuated in the faeces.

Course.

Mild cases recover rapidly. The disease is always much milder in adult cattle, the intestinal haemorrhage ceasing after a day or two and the diarrhoea soon afterwards. The average duration is about 5 to 10 days, but in very severe cases the animal may die in 24 to 48 hours. Sometimes the condition becomes chronic, and the animal may pine for months before it finally dies from debility. At times pneumonia and nephritis may be complications.

The mortality varies considerably. It may be as high as 50 per cent. or as low as 3 to 5 per cent.

Lesions.

The most striking lesion is intense redness and swelling of the intestinal mucous membrane. So much of the epithelium is destroyed that some of the small blood vessels open directly into the lumen of the intestine, causing the profuse haemorrhage which is so characteristic of the disease. The mucous membrane is corrugated and denuded of epithelium in parts; its surface is covered with a semi-fluid, bloody material containing blood clots and shreds of epithelial debris.

The large intestine is always the most seriously affected. Sometimes the lesions extend into the last part of the small intestine, but the major portion of the small intestine seldom shows alterations that can be recognized with the naked eye.

Large numbers of the parasite may be readily found in the bloody contents of the large intestine, or in sections of the bowel.

Immunity.

Animals which have recovered from an attack of coccidiosis are considered to have developed a strong resistance to infection with the same type of parasite. If the same animal contracts the disease a second time, an examination will show that another species of the parasite should be incriminated as the cause. The immunity which an animal develops is associated with the persistence of coccidia in the digestive tract. The recovered animal has acquired a tolerance and remains a carrier for an indefinite period; it may, therefore, disseminate the organisms and thus infect susceptible animals from time to time.

Adult animals that have never shown clinical symptoms may discharge small numbers of oöcysts with the faeces and so disseminate the infection.

Coccidiosis is a disease which is strictly host-specific. Parasites which are pathogenic for cattle are limited to bovines and cannot be transmitted to other species of animals like sheep, goats, pigs, rabbits and fowls. Likewise, coccidiosis of any of these animals is strictly specific.

Diagnosis.

When a young animal suffers from diarrhoea which is associated with the evacuations of blood, mixed with mucus and shreds of ephithelium, coccidiosis should be suspected. But a positive diagnosis can be made only by the recognition of large numbers of oöcysts in the faeces. When the oöcysts are present only in small numbers, coccidiosis is probably not the main cause of the diarrhoea, and other contributory causes must be looked for.

For the diagnosis of coccidiosis, therefore, it is advisable to submit the following specimens to the laboratory for examination : :—

(1) In the living calf, portions of the bloody discharge and mucus should be submitted in either 1 per cent. bichromate silution or in 10 per cent. formalin.

(2) If the calf is dead, a piece of the intensely red intestine is removed and tied at each end so as to retain the contents. This is then placed, together with a piece of liver and spleen, in 10 per cent. formalin. The liver and spleen are required for the determination of paratyphoid, which is frequently confused with coccidiosis.

Conditions with which Coccidiosis may be Confused.

(1) *Paratyphoid.*—Whereas paratyphoid usually affects young calves from 2 weeks to 3 months old, coccidiosis is more often found in calves from 2 to 3 months old and older. Moreover, in paratyphoid the diarrhoea is usually yellowish-grey and dirty, but it is bloody in coccidiosis. As a rule the losses from coccidiosis are much less than in paratyphoid. Animals that are properly treated and not exposed to further infection will usually recover, whereas calves affected with paratyphoid will either die or pine for a long time and remain stunted.

(2) *Heartwater.*—The losses from heartwater are also considerable in South Africa, but heartwater occurs in certain areas that are fairly well-defined topographically. Moreover, heartwater infection is effected exclusively by the bite of the bont-tick which is limited to certain sub-tropical areas. Outside these areas heartwater occurs only sporadically, i.e., when infected ticks have been carried with animals from low veld and middle-veld localities, whereas coccidiosis may occur in any part. Although diarrhoea may be a symptom of heartwater, as in paratyphoid and coccidiosis, the most striking symptoms are excitability and other disturbances of the nervous system, which are absent in coccidiosis.

(3) *Arsenical Poisoning.*—In arsenical poisoning, the animal usually suffers from a very severe diarrhoea, which may also cause the evacuation of blood and mucus, but the course is always very rapid, the animal is more depressed and death usually occurs in a day or two. As in cocidiosis, there is redness of the mucous membranes of the intestine, but the redness is less intense than in coccidiosis, and occurs throughout the small and large intestine, whereas it is limited mostly to the large intestine in coccidiosis. Moreover, in arsenical poisoning there is reddening of the fourth stomach. The presence of arsenic can be determined by an analysis of stomach contents and parts of the liver; for a diagnosis of coccidiosis the bloody contents of the large intestine should be examined for oöcysts.

(4) *Scours.*—Diarrhoea in calves can be caused by irregular and improper feeding or by feeding materials that cause irritation of the intestine. On an examination of the intestinal discharges and of portions of the liver and spleen it will be possible to exclude both coccidiosis and paratyphoid.

Prophylaxis.

Prophylactic measures should be adopted that are unfavourable for the survival of the parasite and for its transmission from animal to animal. As affected and carrier animals are the chief sources of infection they should be carefully isolated and their discharges properly disposed of. By eliminating the carrier or by rendering its faecal discharges innocuous, transmission of coccidiosis to young susceptible animals will become very difficult. The object of the prophylactic measures adopted should be to prevent the ingestion of large numbers of sporulated oöcysts. A few parasites picked up intermittently, are more likely to produce a certain degree of resistance against gross infection than to cause much disturbance of health.

Under conditions of ordinary temperature and moisture, and provided there is a free supply of air, the oöcysts require a minimum period for its sporulation, or for reaching the infective stage. The species of coccidium affecting the bovine needs about two weeks, but some of the species found in small animals require barely 30 hours before the infective stage is reached. When kept within the limits of -2° C. to 37° C., the oöcysts will survive for about a year, provided that desiccation or exposure to the action of bacteria or the rays of sunlight is not allowed.

The following prophylactic measures are advised:—

(1) *Stable Hygiene.*—The stables must be well constructed with sloping concrete floors. No manure should be allowed to accumulate and the stable floors must be thoroughly cleaned and washed every day. If the infection is severe it may be advisable to keep the calves stabled up to the age of 6 months. The water and food provided must be clean, wholesome and free from infection and renewed at least once a day. The animals should not be allowed to graze unless the pasture is clean.

When it is not possible to provide suitable stabling facilities, the animals should be tied up next to the manger in such a way that they cannot pick up particles of manure or contaminated food or water.

(2) *Disposal of the Manure.*—The manure should be regularly removed from the stable and allowed to ferment in a manure or a compost heap; the heat evolved during the fermentation will raise the temperature of the manure to 50 or 60° C., which is detrimental to the oöcyst. The infected animal, showing clinical symptoms, therefore should be kept isolated in a suitable stable so that its evacuations can be collected and properly treated in the manure heap.

(3) *Disinfection.*—As the oöcysts are remarkedly resistant to the action of most of the common chemical disinfectants, disinfection of contaminated premises, food and faecal material generally cannot be relied upon. Horton-Smith, Taylor and Turtle (1940, cited by Henning, 1948), have however, found that ammonia is extremely lethal for the oöcysts of coccidia. Gaseous ammonia used in a dilution of 3 ounces per 10 cubic feet capacity will destroy all the accessible oöcysts. On the other hand, Enigk (1944, cited by Henning, 1948) has shown that a mixture of carbon bisulphide (4 parts) and raw cresol (1 part) is extremely effective for the destruction of both coccidia oöcysts and Ascaris eggs.

(4) *Infected Veld.*—When infected cattle are allowed to graze they usually contaminate the pasture by means of their faeces. If there is sufficient moisture, and the temperature is suitable, the injective stage is soon reached. But as the pasture remains infected for several months susceptible animals should not be admitted unless the area has been kept free of cattle for at least a year.

(5) *The Carcase.*—It is not necessary to burn the carcase of an infected animal. If it is not opened, but intact, the decomposition that normally ensues will destroy the oöcysts present in the intestine.

Treatment.

Although prophylaxis is the most effective method of dealing with coccidiosis, the treatment that the sick animal receives and the thoroughness with which the evacuations are disposed of will markedly influence the course of the disease.

(1) *General Treatment.*—The sick animal must not be allowed to run about, but should be housed in a stable or stall with a sloping concrete floor that can be thoroughly cleaned out every day. All the manure should be placed in a manure or compost heap where it can undergo fermentation. The water used for cleaning the stable should be suitably disposed of so that it cannot spread the oöcysts. As long as the animal is housed, the oöcysts can be gathered with the manure and destroyed, but if it is allowed to run free, the parasites will be disseminated on the pasture and so favour the spread of the infection.

If it is not possible to provide suitable stabling facilities, the sick animal should be tied up so that the manger or feeding trough cannot be contaminated by manure or soil.

Wholesome food, clean water and clean bedding should be provided. If suitable stabling has been provided and reinfection is prevented, the natural powers of the animal will generally overcome the infection and spontaneous recovery without medicinal treatment will be the result. After a number of asexual generations in the intestine the animal's own resistance limits further multiplication, fewer cocidia are produced and clinical symptoms gradually disappear. But further multiplication and exacerbation of the symptoms will occur if re-infection with ripe sporulated oöcysts is allowed. For the continuous propragation of the parasites, a sexual cycle of development inside the intestine, followed by sporulation under suitable conditions outside the body, is essential. By preventing re-infection with sporulated oöcysts, therefore, spontaneous recovery will generally occur, unless the primary. infection is so massive that the animal's resitance is unable to withstand the invasion. If re-infection can be prevented and the animal recovers, it usually remains a carrier. This carrier state confers on it the immunity which protects it against a subsequent re-infection.

(2) *Medicinal Treatment.*—Many different drugs have been used from time to time for the treatment of clinical symptoms of coccidiosis. Some of these have been claimed to be effective. But none of these claims could stand the test when properly tried out. In most cases where drugs have been used, suitable hygienic measures have been adopted simultaneously; it is these hygienic measures rather than the drugs given that have been responsible for the beneficial results obtained.

It is true that the administration of some drugs has resulted in a remission of the symptoms. These drugs include astringent preparations like tannic acid and wattle-bark extract. Tannic acid is a very light powder; the dose for a calf is 1 to 3 teaspoonsful given twice a day in about

5 ounces of raw linseed oil or in 10 ounces of water. A heaped-up teaspoonful of wattle-bark extract is mixed with a bottle of water, of which a cupful is administered three times a day.

Lately, various sulphonamide preparations have been employed for the treatment of coccidiosis. These include sulphaguanidine, sulphamerazine, sulphamezathine, sulphanilamide and others; the dose by the mouth is 6 grams (a heaped-up tablespoonful) per 100 pounds body weight per day. Parkin (1948) has obtained excellent results in dogs with suphanilate when given in the form of an enema. It is possible that other animals will also benefit by the administration of sulphonamide per rectum.

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Useful Bulletins.

The following are a few of the bulletins obtainable from the Editor of Publications, Department of Agriculture, Pretoria, post free and prepaid at the prices indicated:—

Poultry Farming.—Bulletin No. 241, by Dr. J. J. Bronkhorst. Price 1s.

Poultry Houses.—Bulletin No. 257, by C. L. Marais and N. J. van Straaten. Price 1s.

Turkeys.—Bulletin No. 264, by E. F. Lombard and Prof. A. M Gericke. Price 3d.

Classing of Poultry or the Culling of Non-Producers.—Bulletin No. 207, by P. J. Serfontein. Price 3d.

The Small Hive Beetle.—Bulletin No. 220, by Dr. H. E. Lundie. Price 3d.

The Production and Handling of Cream.—Bulletin No. 219, by P. Toens and P. du Preez. Price 3d.

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NOTE.—Items marked with an asterisk (*), are papers read by professional Officers of the Division of Agricultural, Education and Research at a Conference held in Pretoria, and referred to in an Editorial in the July issue of " Farming in South Africa."

[*Photo on Cover*: Famous Vineyards at Paarl, C.P.]

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FARMING IN SOUTH ... AFRICA

VOL. 23 OCTOBER 1948 No. 271

Editorial:

A New Venture of the Department.

THE establishment of the Natal Agricultural Research Institute in association with the University of Natal is further evidence of the Department's effort to serve the needs of the country as regards an expanded programme of agricultural research and the training of technical personnel.

As in the case of the Stellenbosch-Elsenburg College of Agriculture and the Agricultural Research Institute of the University of Pretoria, the new Institute is of dual nature in its functions and under dual control, in the sense that its academic activities fall under the control of the University, while its research and other activities are the concern of the Department.

That its establishment is amply justified has been shown by the good response in the enrolment of students and by the obvious necessity for more research under conditions of soil and climate differing very largely from those in the rest of the Union.

Despite the policy of bilingual instruction, many students have come from territories outside the Union. Amongst non-Union nationals Rhodesians and Kenyans predominate and make up nearly a third of the enrolment in the Faculty. (The University has arranged a special course in Afrikaans, to be taken during the First Year, for unilingual students.)

It is therefore abundantly clear that the responsibilities of the new Institution wil extend far beyond the borders of the Union, certainly as regards its academic work and later possibly also as regards research. There are many problems relating to the agriculture of the area which require investigation, and the Institute will be in a favourable position to do its share of the work when once the necessary technical facilities have been created.

These problems are numerous and varied, owing mainly to the great diversity in climate and soil. It is not a rare exception to find extensive sheep ranching, for instance, being carried on only a few miles from sub-tropical fruit production. Even on the same farm one sometimes meets with all types of farming, ranging from that appropriate to cool temperate areas at the one extreme, to sub-tropical at the other.

Accordingly the investigational work of the Institute necessarily has to cover a wider field than in most other parts of the Union. The area east of the Drakensberg lends itself to considerably more intensification of farming, because of the great advantage it enjoys in having a relatively high and fairly reliable rainfall over its larger part.

Since the generally mountainous topography limits very severely the amount of land which can safely be put to the plough, a foremost task will be to discover the best methods by which the fullest use can be made of the natural veld. This implies a good deal of research basic to effective soil conservation. That there is also an important research aspect to soil conservation is all too frequently overlooked. We need to have a more detailed classification of our soil types as a basis for

correct land use and to know very much more about the soil itself: its response to fertilizer and cropping treatment, and the factors which influence or determine its erodibility.

In this connection the introduction and testing of perennial pasture plants, or the development of such types of breeding, will occupy an important position in the research programme. Much of what is so freely said about building up the organic matter content of our soils, through the addition of manure or compost, bears little relation to the facts of the case. While the fertilizing value of these substances cannot be questioned, the evidence available is almost wholly against any practical possibility of their use resulting in more than a fleeting increase in the organic content of the soil *under our climatic conditions.*

One method, which holds out the possibility of at least maintaining, if not increasing the amount of organic matter in the soil or of preserving a desirable soil structure, is the regular use of semi-permanent pasture leys in rotation with annual crops. Ley crops serve a double purpose: they hold the soil in position while occupying the land, and they slow down the rate of decomposition of organic matter to the extent that the loss of organic reserves is usually more than counterbalanced by the formation of new organic matter through root decay. Moreover, the presence of large masses of roots when the ley is ploughed up, is in itself sufficient to impart a desirable physical condition to the soil.

The trouble is that few ley crops adapted to our climatic conditions and meeting the requirements of practical farming are available. The successful discovery or development by breeding of more suitable ones merits much greater effort than has been devoted to the matter in the past. Indeed, it is probably no exaggeration to say *that the wholesale incorporation of such crops into our farming systems, especially in the main grain producing areas, is likely to do more for soil conservation in its wider sense, for the improvement of soil productivity, and for the stabilization of crop production than any other single method we can apply.*

There are, of course, a host of other, perhaps more fundamental problems, requiring attention. A closer study of the soil organic matter itself—its formation, properties, decomposition, and the part it plays in soil productivity, will doubtless enable us to see the issues involved in clearer perspective. The crop plant, its physiology and reactions to different conditions of soil and climate, offers equally wide scope for research. Of outstanding general significance is the relationship between the soil, the plants grown on the soil, and the health and development of the animals fed on the plants. Recent researches overseas have shown that the nutritive value of herbage is greatly influenced by soil properties and that in the feeding of animals *quality* of the feed, as determined by the fertility or infertility of the soil, is just as important as the kind and the quantity.

It is frequently being claimed that we are already sufficiently far advanced in our research to call a halt for a time and concentrate on translating the results so far obtained into agricultural practice. What is lost sight of is the fact that the meagre data at our disposal have taken a long time to accumulate and that research must, by the very nature of things, keep abreast of practical application, otherwise agricultural advance will be doubly retarded.

Particularly great is the need for research of a more fundamental kind. A significant comment in this regard is the passing of special legislation in the U.S.A. in 1946, and the provision of large sums of money to promote more fundamental agricultural research—and this in a country which has been leading the world in agricultural research for many years!

[*Continued on page* 667.

The Production of Potatoes.

J. P. F. Sellschop and J. J. du Toit, College of Agriculture, Potchefstroom.

POTATOES are a very important item in the diet of our European population. Natives, too, are consuming more and more of this product as they move from the country to the towns and cities.

Few crops are susceptible to such a wide range of fluctuation in price as potatoes. Consequently their cultivation may at times yield particularly high profits, whilst at other times, heavy losses may ensue as a result of glutted markets or damage caused by unfavourable weather conditions. The best policy would be to cultivate the crop regularly and not only when market prices are high. Erratic large-scale plantings when prices are high usually result in glutted markets.

FIG. 1.—A field of potatoes, Westminster, O.F.S.

Regular cultivation of this crop is an important requirement in order to gain the necessary experience, for few other crops require such a thorough knowledge of cultivation practices, diseases and insect pest control and selection of suitable seed. Production costs may, for instance, be decreased considerably if seed potatoes need not be bought every year but can be produced by the producer himself.

The chief object in the production of potatoes should be to obtain high yields per morgen and to produce a marketable product on an economic basis. Low yields usually do not balance the costs of production, while potatoes of poor quality are not easily disposed of unless there is a serious shortage. Due to the introduction of voluntary and compulsory potato grading systems on the most importants markets in the Union, it has become more and more essential to follow methods of cultivation which will ensure the production of healthy, good-quality potatoes.

Climatic Requirements.

The crop can be cultivated under a wide range of climatic conditions, provided the rainfall is regular or irrigation is possible. Consequently, it is cultivated with success in comparatively warm areas such as at Vaalhartz, or in fairly cool areas such as the higveld. The crop is, however, not resistant to cold and is primarily a summer crop, although it can also be cultivated succesfully as a winter crop in frost-free areas.

Irregular moisture conditions constitute the most important limiting factor in succesful potato production. Droughts of 20 days or longer are usually fatal, especially when the plants are in the critical stage of tuber development. Drought and heat after the tubers have been formed, often promote the development of internal brown fleck or spots in potatoes, especially if the soil is deficient in phosphates and lime.*

Soil Requirements.

Potatoes can be cultivated on a large variety of soils, but for the best results, the crop requires fertile, sandy loam soil, which will drain well after heavy rains and yet remain damp and cool for a long period.

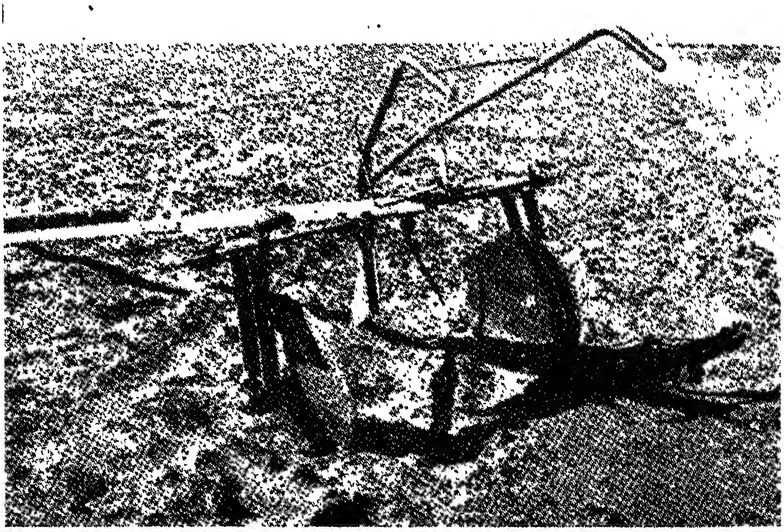


FIG. 2.—An implement for earthing-up potatoes.

[*Photo : C. Haagner*

Heavy clayey soils which drain poorly and are difficult to cultivate, must be avoided. The same applies to eelworm-infested soils or very shallow, sandy soils with gravel outcrops. Potatoes are more inclined to develop internal brown fleck in such gravel patches than in good soil. New soils with their large supplies of organic matter are particularly suitable for potatoes, provided that the soil has been properly ploughed and brought to a fine tilth.

Rotational Cropping.

It is essential that potatoes should not be cultivated continually on the same land. In order to control most diseases, especially eelworm, it is advisable not to grow potatoes and related crops, such as tomatoes

*For further particulars about internal brown fleck, see Science Bulletin No. 156 by Dr. J. E. van der Plank.

and tobacco, more than once every three or four years on the same land. Eelworm or root gallworm affects the appearance of the tubers and hampers the infected plants in their growth.* This pest usually determines which crop may be grown in rotation with potatoes. Maize, kaffircorn, winter cereals and most grasses are suitable for rotational cultivation with potatoes, although some of these crops are, to a small extent, also susceptible to eelworm. Legumes such as beans, cowpeas and soybeans, as well as other crops such as sunflower, pumpkin, etc., are very susceptible to eelworm infection and must therefore preferably not be included in a system of crop rotation with potatoes. These crops will not introduce eelworm into the soil, but if the pest is already present, eelworm will develop rapidly in the roots of these crops. The practice of interplanting pumpkins and maize often results in the failure of crop rotation. Legumes such as sunn hemp, groundnuts and velvet beans are highly resistant to eelworm infection and are particularly suitable for purposes of crop rotation, provided that they can be grown

FIG. 3.—Potatoes earthed up well.

succesfully in the area concerned. Where potatoes are cultivated under irrigation and there is a lack of manure or compost, it is wise to cultivate sunn hemp in rotation with potatoes for green manuring.

Soil Cultivation.

In order to obtain the best results with potatoes, the soil must be ploughed deeply and cultivated thoroughly. The optimum depth for ploughing in most soils is 7 to 8 inches. It is advisable to plough early so that there will be time to destroy all weeds once or twice with a disc-harrow or an ordinary drag before planting the potatoes. If nutgrass† infestation is severe, the soil can be ploughed *shallow* at intervals of 2 to 3 weeks before the potatoes are planted. The rhizomes of nutgrass often penetrate potato tubers.

Planting Time.

In areas where frosts occur during the winter months, potatoes may be planted as early as the middle of August or during September as soon as the weather becomes warm and the risk of late cold has passed,

*For full particulars on the control of eelworm, see reprint No. 41 of 1948 by Dr. W. J. van der Linde.

†*Cyperus esculentus et rotundus.*

provided that moisture conditions are favourable and the seed potatoes have started to sprout. If irrigation water is lacking, potatoes ought not to be planted before regular rains can be relied upon. In the highveld October or November are ususally the best months for planting, although plantings as late as January may also be successful. In the western Transvaal and in many other areas, December is a good month for planting, provided the rainfall is regular. Such crops may usually be left in the soil until late winter, while those which are planted earlier must be lifted sooner, as the danger exists that the ripe tubers may begin to sprout in autumn. Market prices are usually not as good then as towards the end of winter. On the other hand, it should be pointed out that potatoes which are planted as late as January or the beginning of February will, as a rule, yield considerably less per morgen than those which have been planted earlier. This is particularly the case with the Up-to-Date variety which needs a growing season of 4 to 5 months for the best development. Furthermore, late blight* is a greater danger to such crops.

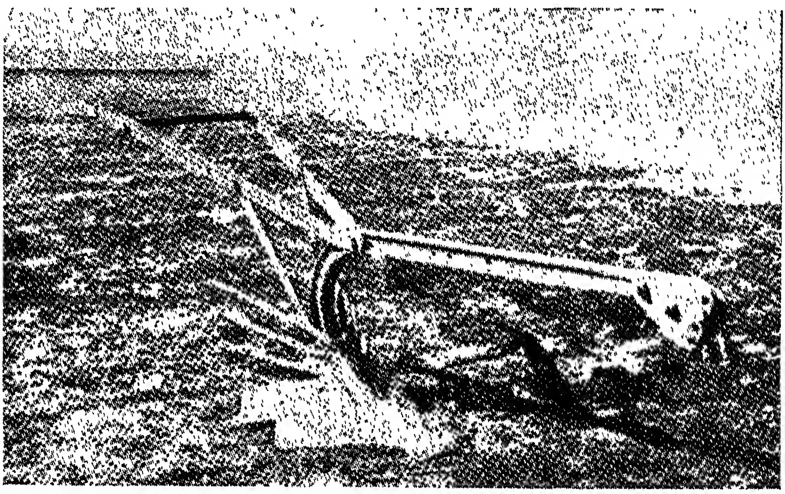


FIG. 4.—A potato lifter. (*Photo: C. Haagner.*

In areas free from frost, where potatoes may be cultivated as a winter crop, they are, as a rule, planted from April to July. From the results of experiments carried out on the Letaba in the lowveld, it appears that the middle of May seems to be the best planting time for that area. Crops which are planted later are not able to develop sufficiently before the coldest months and are often infected with late and early blight† in spring.

Methods of Planting.

Two planting methods are generally followed, viz., the ridging or open-furrow method and the flat system, in which the seed potatoes are planted behind an ordinary plough or a disc-plough in every third or fourth furrow. The open-furrow method is applied under irrigation. The furrows are made 3 to 4½ feet apart by means of a ridging plough, and after manure, fertilizer and the tubers have been placed in the furrows, the ridges between the furrows are split with the same ridging plough and the other furrows covered up in this manner. The new furrows are

*Caused by *Phytophthora infestans* (Mont) de Bary.
†Caused by *Macrosporium solani*. E. & M.

used for irrigation purposes. Another method of closing up the open furrows in which the tubers have been planted, is by using a disc ridger. This implement needs less draught than a ridging plough and leaves the soil practically level. Under dry-land conditions the surface should preferably be level after the tubers have been planted, as there is less evaporation on a flat surface than on a ridged one.

The open-furrow method of planting has the further advantage that the making of furrows is not retarded by the planting process.

The second method of planting mentioned above is used more generally. If a tractor is available, the tubers are planted in the third furrow behind a three-furrow plough. Otherwise the operator sits on the plough and drops the tubers between the second and third plough shares. If oxen and a two-furrow plough are available, it is advisable to have a team of oxen with a single-furrow plough as well. The seeds are planted behind the single-furrow plough and the two-furrow plough follows, covers up the tubers and ensures the necessary interval of 3 ft. between rows.

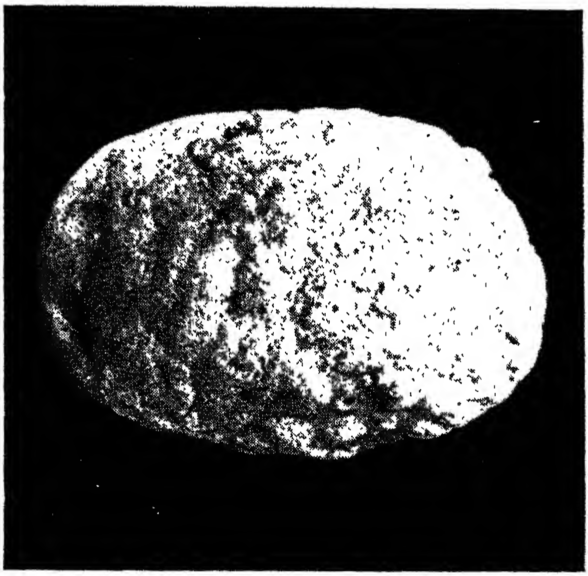


FIG. 5.—Potato covered with eelworm pimples.
[*Photo : C. Haagner.*

Adequate spacings between rows is very important. In any case the rows ought not to be less than 3 feet apart. Where potatoes are grown under irrigation, the mistake is often made to plant behind a two-furrow plough, so that the rows are only 2 feet apart. The result is that the plants are damaged later in the processes of cultivation and ridging. Under irrigation it is better to use more fertilizer in order to ensure higher yields per morgen than to increase the rate of seeding.

On the highveld where the rainfall is comparatively high, it is a general practice to make the rows 3 feet apart and to plant the tubers 15 to 18 inches apart in the rows. In the western Transvaal and other areas, however, where the rainfall is more uncertain, it is more profitable to make the rows 4 to 4½ feet apart and plant the tubers 24 inches to 27 inches apart in the rows. If a tractor is available the furrows may be made 4½ feet apart with a ridging plough, i.e., as wide as the wheel

base of the tractor. The seed potatoes are covered with a disc ridger while the team or the tractor moves between the furrows without fear of injuring the tubers in the open furrows.

Fertilizing.

Of all the important crops, potatoes respond best to ample applications of phosphates, and they are most susceptible to a deficiency of this substance. It is seldom possible to make potato production profitable if the necessary fertilizer is lacking. The crop is a gross feeder which requires heavy fertilizing for good results. It is important to provide potatoes with potash and nitrogenous fertilizers in addition to phosphates, especially under irrigation. Fertilizer mixture F (4 : 10 : 6) may be recommended under irrigation or in areas with a high rainfall. Mixtures C (2 : 12 : 2) and D (3 : 13 : 3) are cheaper and may be recommended in preference to mixture F in areas not deficient in potash and nitrogen. In the western Transvaal, where there is no shortage of potash and nitrogen, superphosphate alone will be sufficient and more economical. From 800 to 2,000 lb. of the above-mentioned fertilizers may be applied per morgen, depending on the rainfall. If kraal manure, karoo manure or good quality compost is available, an application of 6 to 8 tons, together with 600 to 800 lb. superphosphate per morgen, will usually yield satisfactory results on ordinary soil which is not too poor. Animal manure or compost is particularly beneficial to soils under irrigation.

As far as the method of application is concerned, it is usually best to distribute fertilizer along the furrows in which the tubers are planted. The tubers should be placed slightly on one side of the furrow so that their sprouts are not burnt by the fertilizer and they are not trampled on by the draught animals. In order to be able to place both the fertilizer and the tubers satisfactorily in the furrows, more attention ought to be paid to potato planters equipped with fertilizer attachments.

The Necessity of Sound Seed Potatoes.

Good soil, sufficient fertilizer, diligent cultivation and favourable weather conditions all contribute towards a good yield, but none of these factors is of any avail if poor seed potatoes are used. All efforts to produce a good crop will be in vain if sickly or degenerated seed potatoes are used. The tubers must be true to type, sound and vigorous—not old and flabby from prolonged sprouting. Tubers must be free from eelworm and the common potato diseases such as scab, black scab (*Rhizoctonia*), bacterial wilt and other diseases caused by fungi and bacteria, as well as the more insidious diseases which are the cause of degeneration or "running out". Scab, as the name indicates, can be recognized by the scabby spots on the skin, whilst black scab occurs in the form of black spots on the skin. Both diseases may be controlled by dipping the potatoes in a suitable protectant such as "Aretan". The other common disease, viz., bacterial wilt,* cannot be treated effectively, and under no circumstances must infected tubers be used as seed. Infected potatoes rot easily and when they are cut open, a brown ring can be seen where the vascular bundles have rotted around the centre of the tuber. If an infected tuber is pressed lightly, an evil-smelling, yellowish-brown slimy matter oozes out from the ring.† If any doubt exists as to whether this disease or any other is present, samples should be sent for examination to the Chief, Division of Botany and Plant Pathology, Pretoria.

The other class of diseases mentioned above, viz., the virus or degeneration diseases, is of quite a different description. They cannot

*Caused by *Baterium solanacearum.* E.F.S.

†See "Bacterial Wilt in Potatoes", by Dr. V. A. Wager, in *Farming in South Africa*, August, 1945, pages 501–507.

be diagnosed in the seed, and the only way to be sure that seed is sound, is a guarantee that it comes from healthy plants. The diseases are discernible on the growing plants, and although the affected plants may not die, they grow feebly, so that only low yields are obtained. If infected tubers are present in the seed, the diseases subsequently spread from plant to plant, mainly through the agency of aphids. In this way a whole crop may ultimately be infected within 3 or 4 years, although relatively sound tubers were used originally. On the other hand, in very cold or very hot areas, aphid infestation is, as a rule, not very severe, so that the spreading of diseases and the resultant degeneration take place more slowly. Much can be done to safeguard seed for longer periods against degeneration diseases, viz., (1) by using Government-certified or imported certified seed, and (2) by abstaining from the planting of degenerated tubers next to, or in the immediate vicinity of healthy tubers, and (3) by roguing all plants which show visible signs of degeneration diseases, preferably in the early growing stages.

If tubers of various origin have to be planted on the same land, they should be separated by a strip of 50 yards wide or more planted to a tall crop. The use of small tubers, i.e., lighter than 1½ ounces, ought

FIG. 6.—A vigirous and healthy potato plant.

further to be avoided, as virus-infected plants are inclined to form small tubers, and the latter do not, as a rule form strong plants under dry and other unfavourable conditions. This, however, does not mean that all small tubers are necessarily infected with virus diseases.

Quantity of Seed per Morgen.

This will depend on the size of the tubers and the espacement. With a spacing of 3 feet by 18 inches, the following number of bags (150 lb. each) per morgen will be required, viz., approximately 12 to

17 bags in the case of tubers weighing 1½ to 2 ounces; 20 to 25 bags in the case of tubers weighing 2½ to 3 ounces; and 25 to 42 bags in the case of tubers weighing 3 to 5 ounces. In the case of larger tubers it would pay to cut them lengthwise and plant them directly in damp soil.

Sprouting of Tubers.

Before being planted, the tubers should have sprouted or show signs of sprouting, otherwise a very poor and uneven stand will result. In spring it is usually not difficult to induce sprouting in tubers which have gone through a rest period during the winter. If kept indoors in bags in a warm spot, or under straw in the sun, they will usually start sprouting within 8 to 10 days, provided that the weather remains fairly warm. They can also be placed in shallow pits and covered with straw and stable manure. Care must be taken, however, that the tubers are not continually in a moist condition or in a stuffy atmosphere, for then rotting may take place.

If tubers must be kept for a long time in spring before being planted, they are inclined to sprout continually, with the result that they deteriorate in vigour. It is a good idea to spread them out thinly in the shade under trees or in a well-lighted storehouse for, say 14 days after they have been lifted in order to green them. Every third or fourth day they must be turned so that the bottom layer is also exposed to *indirect* sunlight. After this period of greening the tubers are bagged again and stored in a cool spot. A storehouse, built partly underground, with a thatched roof and provided with sufficient means of ventilation, is very suitable for this purpose. Other methods of storing consist in packing the tubers on wire shelves* in a cool building or on straw under shady trees in long stooks, approximately 2½ feet high, covered with straw. The greened potatoes will develop strong, thick-set sprouts instead of long, pale ones.

From the results of experiments carried out at the Grootfontein College of Agriculture and elsewhere, it appears that sprouts of 1½ to 2 inches long may even be rubbed off twice without unduly detrimental effects. On the whole, however, experience shows that it is an unwise practice to allow tubers to dry out too much or to allow them to spend their vigour by prolonged sprouting before being planted.

Suitable Varieties.

According to experiments and general experience, it appears that the Up-to-Date variety is by far the best in the summer rainfall area, although varieties such as Flour Ball, Green Mountain and others are also cultivated occasionally.

In the western Cape Province varieties such as Arran Chief, King George, Green Mountain, Katahdin and also Up-to-Date are the most popular.

Cultivation of the Crop.

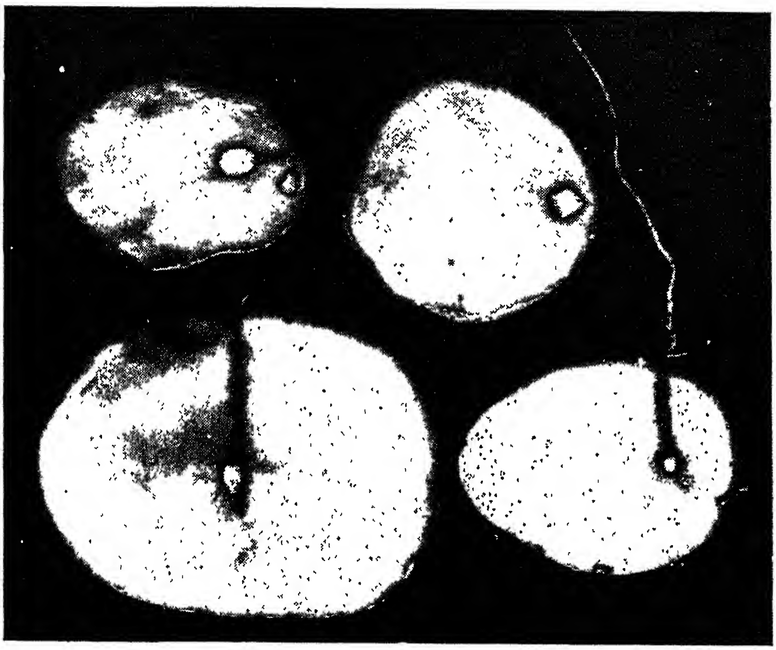
It is absolutely essential that young plants should be kept free from weeds and the soil loose. If necessary, the potato-land may be harrowed before the plants come up, in order to break up the soil crust. A second harrowing may usually be carried out successfully when the young plants are firmly established. After that the crop must be cultivated regularly when weeds appear and as the soil forms a crust. When the plants start flowering, they may be ridged systematically with a view to protecting the developing tubers from infestation with larvae of the potato tuber

*Or in special flat open trays stacked on top of each other.

moth.* If potatoes have to be left in the soil till late in autumn or winter, it will be necessary to ridge the rows thoroughly and close up all cracks in the soil.

Irrigation.—If sufficient water is available the first irrigation ought to take place before the tubers are planted, unless the soil has been moistened by rain. The next irrigation should be postponed until all the plants are up and the soil has become dry again. After that light irrigations may be applied every 8 to 12 days. It is advisable not to irrigate during the hottest time of the day. Neither must the whole surface be flooded; instead, the water should trickle through to the plants sideways.

Harvesting Time.—The potatoes are ready to be lifted when the skins do not come off readily and the plants start dying. If, for some reason, the potatoes have to be lifted when the skin still comes off easily,



Nut grass (*Cyperes esculentus*) " uintjies " grown into potatoes.

the plants can first be pulled up and the tubers lifted 6 to 8 days later, when the skin will be firmer. The land should not be irrigated but remain dry after the plants have been pulled up.

Various implements are used for lifting potatoes. A type of ridging plough with raisers consisting of rods a few inches apart, instead of solid mould boards, is generally used. For further particulars dealers in agricultural implements may be consulted.

† *Grading of Potatoes.*—The purpose of grading is to market products of uniform quality and appearance. In grading potatoes care should be taken to see that diseased, damaged, injured and misshapen tubers are removed and that sound, well-formed tubers are carefully sorted out according to size. Each separate quality or size is usually demanded by a specific group of consumers. The presence of a few

**Phthorimaea operculella* Zell.

†Full particulars about grading of potatoes for marketing purposes are obtainable from the Chief, Division of Economics and Markets, Department of Agriculture Pretoria.

particularly small or large tubers in the same bag may arouse the suspicion that the whole consignment has been graded irregularly. Tubers pierced by nutgrass and watery or glassy tubers, cause the most difficulties in the grading of potatoes from the Transvaal highveld. Misshapenness and damage by insects (potato tuber moth) are, as a rule, largely responsible for the rejection of potatoes from the eastern Orange Free State. Internal brown fleck, mostly occurring in crops which have been planted early, is the main cause of dissatisfaction with potatoes from the western Transvaal. In the lowveld sunburn and rot cause most complaints. These latter shortcomings can both be prevented by the introduction of more organic matter into the soil, timely planting of sound, sprouting tubers, careful ridging of the plants and keeping the lifted tubers in a cool and airy spot.

Yields.—Under irrigation, summer yields of 300 or more bags per morgen may be obtained if conditions are favourable and provided healthy tubers were used. Under dry-land conditions yields of 200 to 250 bags per morgen may be obtained on the highveld, whilst in areas with a lower rainfall, harvests of 80 to 160 bags per morgen may be considered reasonably good. The yields of the Transvaal lowveld and of the Natal highveld seldom exceed 150-200 bags per morgen.

Veld Management in South Africa.

OUR natural grazing is the most useful, most inexpensive and most valuable source of feed for the Union's livestock, but if we wish to use this cheap source of feed to the best advantage, veld management is essential. A valuable bulletin, *Veld Management in South Africa* (Bulletin No. 278, price 3d.), by Prof. J. D. Scott, who for eleven years was the Officer-in-Charge of the Research Stations at Estcourt and Tabamhlope, Natal, was published recently. This bulletin gives a summary of the results of field experiments carried out in the Union. He points out that the Union can be divided into numerous agro-ecological regions differing from one another in soil and climatic conditions. In a classification of the Union, his map shows more than thirty specific grazing regions, in only fourteen of which research work has been carried out.

In this bulletin Prof. Scott gives a brief description, together with sketch maps, of different parts of the Union, of these fourteen regions and then, after a summary of the characteristics of the sweetveld, mixed and sourveld, discusses the various systems of veld management recommended for these regions. It is not a description of all the systems tested out, but merely a summary of the most important systems and those which may be most generally applied.

In a summary of the data he enunciates a few principles of veld management revealed by his investigations, which, if applied, will bring about a considerable change in the productivity of the country.

In two annexures to the report, he discusses problems relating to veld-burning and hay-making methods. In connection with veld-burning he mentions a fact which is often disregarded, viz,: "Only too often does bad veld management, or complete lack of management, follow veld-burning carried out at the correct time. The harmful results are attributed to veld-burning and not to the bad management which, even without fire, would have ruined the veld in the long run".

"Veld Management in South Africa" (Bulletin No. 278) is obtainable from the Editor, Department of Agriculture, Pretoria. Price 3d.

Pig Production.*

Dr. P. J. v. d. H. Schreuder, Professional Officer, Division of Agricultural Education and Research.

ALTHOUGH the average farm is not complete without pigs, the right place for the pig is in a diversified system of farming, where there is a surplus or wastage from the cowbyre, garden and fields. Stud breeding does not combine satisfactorily with a commercial pig proposition, and even in a mixed-farming system, pigs will pay best if there are enough of them to take all the wastage and surplus from the other producing sections.

The average dairy farmer grows sufficient crops to maintain his herd, and most likely has also established pastures which will enable him to combine sty and free-range conditions for his different lots of pigs—weaners, dry sows, baconers and porkers.

When carried in the right proportion and at the right time, the right type of pig is an exceptionally economical producer of very high-grade and wholesome meats. He pays in cash for feeds and by-products that most often have no market value and which without pigs would be mere waste. The farmer who consistently follows up the business on conservative lines can always be sure that pig rearing brings returns.

Prospects in the Union.

A great potential market exists in South Africa itself, where the consumption of pig products is very low indeed and averages only 5 lb. per capita per annum. A greater local consumption and a better type of pig and better fed pigs, will be great aids in the solution of an established pig-production scheme. In no other animal proposition is over-production so easily reached, because the pig is very fecund and matures at an early age, while it is also a very healthy animal and most self-maintaining. In unorganized and unbalanced farming conditions, there is naturally a great amount of waste; the overproduction in pigs is wasteful. Pigs are often either muck or money, and the farmer must always be guided by the watchword "not how many, but how good". For years attempts were made to organize our pig industry, but the profits from cash crops and other more lucrative pursuits made us scorn the humble pig. We must make serious attempts to rehabilitate our pig-production propositions, for we cannot look to overseas markets, until our local markets are properly organized and our pig production has become part and parcel of an established and paying farming practice.

It has been found that the pig is most profitable when it can be raised on products produced for human consumption, but which are of inferior quality, and also their by-products. In England, during the war and in fairly recent years also in France, much of the milling offals were incorporated in the bread of the people, so that pig-keeping ceased to be profitable and pig production declined.

Reviewing the position in different countries where pig production is practised on an extensive scale, it will be seen that this is always associated with another industry, and utilizes material that otherwise woud have gone waste. In Denmark and New Zealand it is the dairy

* The third and revised edition of the bulletin on "Pig Production" is now in the hands of the Government Printer, and publication may be expected towards the beginning of next year. This article is part of the general introduction to the bulletin, and is published to serve as a guide to prospective pig farmers.

industry, in Germany, potatoes, and in the United States of America, maize. Meat produced as a by-product in this way is able to compete more favourably on the world's markets than that which is produced as the main source of output. The chemical composition of the foodstuffs available also determines economically the nature of the commercial outlet for the supply and the type of animal produced. The lard type of pig was, for instance, produced in the maize belt of the United States, which supplies mainly carbohydrate feeds. Bacon again, is the chief product of Denmark, where the skim milk and whey from the dairy industry supplies a staple ration of protein feedstuffs.

In South Africa there is as yet not this close relationship between pig production and the available by-products of human food. It would appear that available markets determine, to a large extent, in which areas pig production can be most profitably carried on. In many cases pigs are farmed haphazardly. With regard to the dairy industry in Natal, there is a fairly close relationship, but this cannot be said with regard to the maize and potato industries. When maize is fed to cattle, about 20 to 25 per cent. is wasted if pigs are not used to pick out the undigested maize from the faeces. Only a very limited amount of potatoes is used for pig feed. There would be a greater stability in the potato market if all inferior or excess material could be utilized to produce meat. For bacon production it is an excellent ingredient in the pig's ration, on account of the hardening effect on the meat. The only drawback is that potatoes must be boiled or steamed, and this is probably the reason why potatoes are not used to a greater extent.

First-grade products are the fruits of organized farming and manufacturing enterprize, and if we are to realize the benefits of a good livestock country, we must at once set about reorganizing the pig-rearing branch. The main features in such a rehabilitation scheme would be the restriction of pigs to diversified farming propositions, where they fit in best and where best and cheapest facilities exist to produce the best; a strict grading system on our local markets; compliance with the export grades which exist on the British markets; definite and approved methods of maintenance and production, and a more liberal and regular use of pig products in every home. It is with these latter phases that this article is mainly concerned.

The Best System.

The most successful pig proposition is that where the pigs fit in with the other operations of the farm, fitting their numbers to the seasonable amount of waste and surplus feeds.

On the dairy farm, or farm with a diversified system, the weaner lot should coincide when cows are in full flow of milk and when good pastures are available. No other animal gives a higher return for dairy by-products than the pig, and no other feed produces firmer bacon than dairy by-products in the daily ration. The margin between profit and loss is often narrowed, if not obliterated, owing to the lack of efficient equipment, and the pig most often simply becomes a scavenger, a nuisance and not the necessary profitable sideline or established proposition.

A sufficiency of paddocks, portable houses on good sites are first essentials. A sheltered, dry, airy site with plenty of both sun and shade is essential. The paddocks (¼-acre size will do) could be sown to seasonal crops or planted to grass, and the farrowing of sows and weaning of piglets so arranged as to coincide with the availability of grazing, dairy by-products and other feed supplies. Most often the show will be put to the boar in January or February, and after 3 months 3 weeks and

3 days, i.e. May-July, the piglets will bė born and nursed for a further 8 to 10 weeks, before they are weaned in September-October, when summer flow of milk and summer pastures are likely to have made a start.

Pigs should be produced with fair regularity—bacon pigs all the year round because bacon factories cannot operate on a seasonal basis, while porkers have greatest demands during the winter.

Under such a system the sows with a ten-twelve week suckling period become dry in September-October, and it would not be possible to prepare another litter before winter conditions have set in, when feed-stuffs rise in price and profits shrink accordingly.

With only one litter per annum, running costs will be unduly high, owing to maintenance of dry sows for four months in the year. In small propositions where good grazing from established pasture are available, this idle period falling as it does during the summer monts, September-January, is quite inexpensive. In order, however, to fully utilize the cheap dairy by-products during the summer and take full advantage of grazing and crops, it is advisable to provide for an additional lot of weaners to take the place of those that went to the Christmas market. It could be arranged to have one batch of sows to farrow in May-June, and another batch in August-September. The first batch of sucklings catches the Christmas market, and the second batch is sold in March, just when feedstuffs rise in price.

In larger and better established producing propositions, it is generally arranged to secure three litters in 24 months avoiding the exhaustive system of two litters per year. In the three litters per 24 months, due regard is given to the vitality of the sow and fuller opportunity for better development of the litters. Eight months are allowed for each litter; gestation period 4 months; suckling period 2½ to 3 months, and a rest period for the sow of 1 to 1½ months.

Whatever the system, it should be the endeavour of the producer to keep only as many pigs as can be fed as cheaply but as adequately as possible, mainly from by-products, waste and surpluses that are available on his farm. But if the feeds are cheap it must not follow that any sort of pig should be kept. Pigs are cheap and therefore a good type can be produced—pigs that are worth while, that are liked, pigs that other people would like to have and to buy. If not, they will be merely pigs that nobody wants, drags on the market, a waste an eye-sore and a nuisance on the farm.

Pigs are the cleanest, most self-maintained, healthiest and profitable animals on the farm, if the producer treats them right.

The production of profitable pigs is more of a manufacturing process than a farming proposition. The finished product must comply with very definite standards. Misfits and undergrades simply militate against the profitable sale of the right types and grades of finished products.

Breeds and Breeding.

The potential pig-producer wants to know what type of breed he should use when starting pig farming. This will be determined by the demand of internal and overseas markets. Demand for both bacon and pork is fairly consistent. Fortunately both have similar requirements —what suits the one will suit the other. By selection within the breed— most often a bacon breed—ideal baconers and porkers can be produced. The modern demand is for lean meat, and bacon types supply both porkers and baconers with a high degree of excellence. It will therefore

be necessary to describe only the appearance of a good baconer. In one point only do baconers and porkers differ somewhat; heavy shoulders in porkers do not suffer the same disqualifications as in baconers.

The porker should weigh about 100 lb. The head should be light; its body of uniform conformation; level back with well sprung ribs; straight underline, with plump deep and well let down hams; fine quality bone and hair.

The baconer should have a live weight of about 200 lb. The head light; shoulders, light and on one line with the forelegs below and with sides laterally. It should be free from wrinkles and coarseness. Its back must be long, broad and flat, with ribs well sprung. Its sides should be flat, moderately deep, avoiding a barrelshaped middle. The belly and flank should be full, with straight underline and the flank aligned with the sides. The hams are broad, wide and deep to hock; the tail set high.

Bone and hair should be fine, with skin free from coarseness and wrinkles. The legs are short, and set wide apart. The pig should stand well up on the tips of the toes.

From the above descriptions it will be seen that the standards are practically the same, and some writers have drawn the conclusion that the same type of pig will, therefore, be suitable for the production of pork and bacon. In discriminating markets it must not be lost sight of that the standard of the pork pig is applicable to an animal that weighs 80 to 100 lb. live weight, and that of the bacon pig to an animal that weighs 200 lb. live weight.

There is considerable difference in type of baconers even within a breed—the chunkier type, whilst less desirable for bacon, will produce excellent pork because of the propensity to carry sufficient finish at light weights.

There are many breeds of pigs that have been evolved in different countries and different localties to suit local demands and also contemporary trade requirements. For a long while the great demand was for salted pork and fresh pork, and even the bacon and ham of the past was on the very fat and large side. There is a constant change in the tastes and demands of the consumer. During the last half century the increasing demand for bacon, and lean bacon at that, has revolutionized the pig-breeding industry of several countries. Thesee nations were quick in adjusting their pig-farming activities to comply with market demands, and are to-day the leading producers in the colossal trade in bacon on the world's markets. The British market has set a very high standard for bacon. In no other animal product is there such a close relationship between the finished product and the live animal. Only a definite type of pig, bred and fed on the correct lines, can produce the highest quality bacon.

The old axiom that "type is more important than the breed" is more fittingly correct in the case of the pig than in any other animal.

Market demands have so clearly prescribed the final and most important products of the pig—bacon and pork—that their rearing has become more of a manufacturing concern than a farming proposition. To comply with market demands, the pig proposition can be confined to conditions that are obtainable practically anywhere in the world, and on every farm where the necessary feedstuffs are available. The rearing of pigs requires very little land, and the required feedstuffs are practically the same everywhere.

The large number of breeds and types in the Union or anywhere else, leads to great difficulties as regards breeding, feeding, standardization of breeds and finished products, and necessitates numerous investigations

and experiments. The reduction of breeds and types to that minimum which will meet the highest market demands is not only necessary, but has been done most successfully and profitably by those countries enjoying the largest share of trade in bacon on the world's markets.

It is obvious that a bacon pig can produce good pork, whereas a typical porker is unsuited for bacon. The fatter types may fit in where meat is of lesser consideration than fat.

These demands for quality are very rigid and definite, and in limiting our choice of breed and type we must correspondingly stress our standards of type and breed.

The type must meet the highest demands of the most profitable product.

There is no evidence that any one breed is more economical than any other in meeting all the demands of the trade in pig products, but it is clear from experiments in Sweden, Denmark, Great Britain and elsewhere to strengthen the belief that a good bacon type of pig is also suitable for the economical production of even the finest type of pork. The great essential is to produce a pig of first quality fat and lean of correct conformation, and which is profitable to keep.

The Ideal Baconer.

The bacon-producing world requires a pig that will be suitable to kill at certain ages as a porker or baconer of superior quality, of sufficient but not abnormal length, broad and deep chest, shoulders smoothly laid on, sloping towards withers and all other front parts, trim jowl and neat neck with no abnormal fat. It should have a shortish head with good jaws capable of easy feeding and grazing; the ears are of reasonable size and not interfering with normal sight. The ribs must be deep and smooth and even in detph from flank to shoulder; trim, firm, full hams, good feet, straight pasterns and strong tail. The general appearance should be one of, length, uniformity and depth, fullness and smoothness, trimmed down in quality to a sense of breediness and balance. It is a matter of successfully and profitably linking up production with consumption. There are naturally other minor points, but the above features are common to the well-bred, well-developed pig of any breeding, and are generally understood by the average producer. Such features are found in the types of pigs of the leading pig-breeding countries, whatever the names of their breeds—they are the pigs that produce the right products.

Breeds.

In the past it was customary to discuss at great lenght the merits and demerits of the two distinct types of bacon and pork pigs, but the demand of the consumer has so overwhelmingly focused attention on the type that will produce the highest grades of bacon with perfection, that types and breeds not suitable for this purpose have almost completely fallen out of the picture. Accumulated experience in the leading pig-breeding countries has brought the conviction that their best bacon types can also readily and profitably meet other demands of the trade, thus saving the expense and complications that naturally existed in the maintenance and crossing of different breeds.

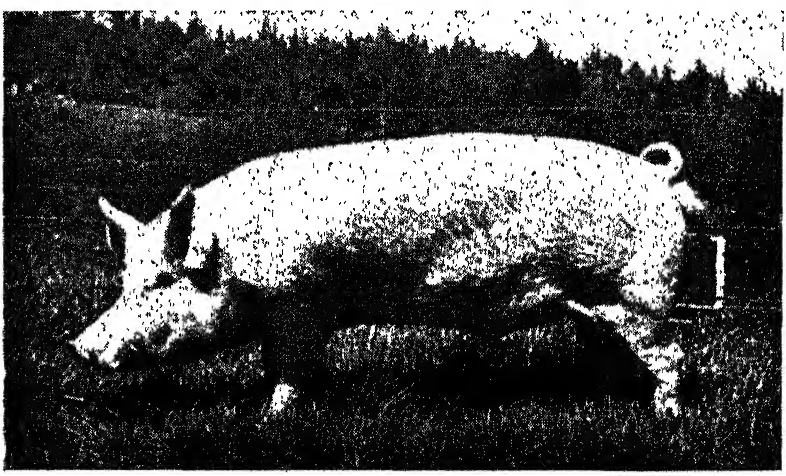
By reason of their conformation, and proportion of leanness to fat, several breeds are designated as bacon breeds. The best of these are the Large White, the Tamworth and the Large Black, while owing to their plumpness, fatness and rotundity the Berkshire, Middle White, Poland, China and Duroc Jersey are suitable where fat pigs are required for lard, salt pork, sucklings and small pork.

The aspirations and ideals of the promoters of the different breeds are practically the same. Apart from meeting the demands of the curer, butcher and consumer, the only differences lie in colour, breed characteristics and other insignificant points. No breed has yet been proved the most economical, but the most extensive and most successful pig-breeding nations have clearly demonstrated that there is a universal type best fitted for the production of the best grades of bacon.

It may serve the purpose of the producer if the leading breed of each type is described here, and only the salient differences in breed characteristics of the other more prominent breeds are mentioned.

The Large White.

This is one of the largest pigs—all white in colour, rather upstanding and of great length, depth and general trimness. It is the very opposite of the thick-set rotund, fat or lard type. No other breed has achieved such world-wide popularity, which is mainly due to the persistent and increasing demand for lean bacon, and the Large White inherently possesses the attributes which were developed into the requirements of a good baconer. This process of selection and perfecting of qualities of



Large white boar.

the earlier type influences the breed to a marked extent. His huge and coarse forbears of the past century have been changed into the clean-shouldered, evenly-fleshed, lengthy and well-balanced pig of to-day. Not only has he changed in conformation, but concurrently improvement of growth and proportion of higher-priced cuts have also been carried out to meet the consumer's and curer's demands. During the long formative period of the breed, its promoters have not lost sight of the good economic productive qualities, but have entrenched these in the modern breed. The fecund properties of the Large White are well known. Prolificacy and good motherhood are characteristics of strain rather than breed, but also in these respects the breed stands second to none.

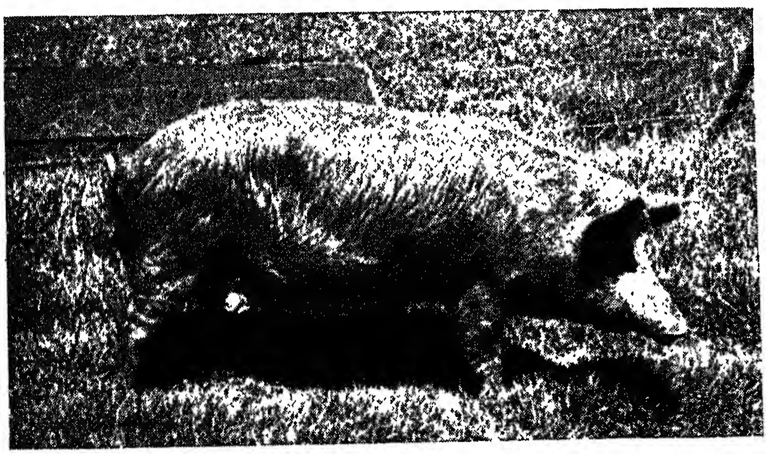
The best type of Large Whites has a good head of medium length, slightly dished, with good width between the eyes, and medium-sized, trim, erect ears leaning but not flopping forward. A chubby, head, small ears, turned-up snout, and short thick neck must be avoided. In this connection it is of interest to note that Canadian breeders have during recent years markedly shortened the snout in order to reduce waste in

the carcase as in the case of the heavy head and longish snout. Length of body, with uniformity of depth and evenness of covering is a feature of the breed. The topline is not unduly curved but never sagging, of uniform width and fairly level. The depth and evenness over ribs is well let down in fore and hind flanks, which gives an oblong, rounded body of great length, neatly set on good trim, fine-boned legs tapering with straight pasterns into good, well placed feet. The skin and hair are of superior quality, and the body should be free of wrinkles throughout.

The breed is very prepotent, and boars run to a great scale of weight when aged. The Large White is distinctly active and hardy, and can adapt itself to a great variety of climatic conditions, and therefore gives much satisfaction under a combination of sty and paddock conditions. The Large White is the great improver of pigs in all the leading bacon-producing countries of the world.

The Tamworth.

The Tamworth is probably the oldest pure breed of pigs in Britain, and is the only all-red pig. It has spread all over the world, but is latterly confined mainly to British countries and the United States. It is a large breed, and in general conformation much trimmer than the



A good Tamworth sow.

Large White. The head is longer, with a finer snout, very slightly dished. The jowl is light, neck muscular but neat, the ears are upstanding and fairly large. The forequarters have neat sloping shoulders, smoothly attached to the longish, deep and even body, with a good top-line and full flanks. The limbs are clean cut and taper finely to good feet. The coat of hair is dense, and is deep chestnut or of a golden-red shade.

The long deep-sided, fine-shouldered Tamworth is considered to produce the leanest bacon. He is a hardy and active pig.

The Large Black.

Although one of the oldest breeds of pigs, the Large Black was only officially recognized during the close of the last century. It is one of the largest breeds, and at maturity scales up to 800 lb. and more. The old-time Large Black was rather coarse, heavyboned, rough-shouldered, heavy jowled, and thick necked. The modern type has gained much in refinement, smoothness and evenness during the first fifty years, but has not met with much favour outside England, except in South Africa, where the risks of sun-scald often gives it a preference

over the white breeds under outdoor conditions. In general appearance it follows the bacon type, but often lacks the quality, evenness and trimness of the desired bacon type. The head is on the large side with large dropping ears lopping over the eyes.

Its main virtues lie in its good ranging ability, good motherhood and prolificacy. These qualities make the Large Black sow a good one for crossing purposes.

The Berkshire.

This breed has recently celebrated its jubilee of registered ancestors. It has a long and distinguished history. It is a black pig with six white points: white feet, spot on the forehead, and white switch. The breed's first claim as a producer of highest quality pork has been proved by its many remarkable successes at show competitions of live animals and dressed meat, especially for small pork. It is, in comparison with the bacon breeds, a shorter, more rotund, and thicker-set pig and is therefore well suited for markets and domestic use where a fat type pig is required.

The Middle White.

For a considerable period the blood of the Yorkshire White pig was common to the Large and Middle White breeds, and on general lines there is still much that is common to the two breeds. As the name indicates, it is medium in size to the Large White. Its true position as a pure breed has been fixed now for a considerable time.

Large black boar.

The breed is noted for quick growth and rapid fattening and is, therefore, best suited for the production of small pork and crossbreeding with bacon breed sires, and for the purpose of producing very light porkers. In general conformation it is shortlegged, more rotund and plumper than the true baconer. The head is shortish, with short ears and a pronounced dish in the face, which is short in the jaw and thick-jowled. The body possesses good depth, evenness and smoothness and the quality of bone, skin and hair is superior.

Crossbreeding.

The vigour of the crossbred is generally admitted. It has been demonstrated in experiments that crossbreds grow somewhat more

rapidly and thus attain correct weights at a lower feed cost than the parent breeds.

The continued supply of crossbreds is, however, often more costly than when purebreds are used from the point of view of breeding stock. The farmer has to keep two boars, one for crossing and another for pure breeding to replace sows culled for age or other defects. As the production of uniform standard-type baconers demands definite strains, the farmer cannot buy sows at random. He must breed his own foundation and producing stock. There is a definite risk in buying breeding stock. Apart from the risk of introducing disease, the breeding ability, prolificacy and constitution of such pigs are often unknown factors. Variation within the breed is always at work, and the breeder must be constantly alert to select and maintain the type or strain which not only conforms to standard, but possesses the vital qualities of prolificacy, sound health and productive vigour. Pigs grow and mature so rapidly that with definite and correct ideals in mind and in application, it is not difficult to select and maintain a foundation pure-bred strain. With such a strain prolific good nursing sows can be selected and bred to different pure-bred sires in successive crosses e.g. a triangular breeding system, using Large White, Tamworth and even Large Black purebred boars.

The Best Sire for Crossbreeding.

Information and experience on this point are available not only from Great Britain and Ireland, but also from the largest exporters of bacon, such as Denmark, Sweden, Holland and other European countries. The consensus of opinion is that whatever the breed of the sow, the sire must be a Large White. The exporting countries have built up their huge export trade in bacon by building up their local white herds by crossing them with Large White boars. The Large White is at least equal to other breeds in rapidity of growth, economy of feeding and prolificacy. With careful selection the average Large White would produce the long lean baconer, light in the shoulder and fine in bone, which is the type preferred by the bacon curer.

There is ample evidence that the Large White is very suitable for the pork trade. Apart from its breeding, the pig is largely a result of feeding, and the farmer who watches market prices can manage to sell porkers or baconers from his crossbred or purebred bacon-breeding proposition.

Claims are often made that the compactor breeds, like the Berkshire and Middle White, are earlier maturing and consequently of greater value for the porker trade, but definite evidence is lacking that these breeds, can actually produce better market returns. The results of different experiments attempting to established breed supremacy in these respects have not, like egg-laying tests, established a leading position for any breed of pig. Most of the claims for superiority of breeds can be ascribed to the variations due to individuality, excellence of strains or to the difference in feeding and management.

For bacon production, a long lean uniform body is required. Indiscriminate crossing does not yield good results, and selection within a breed is preferable. The bacon curers have a definite preference for white pigs. The black breeds produce a certain amount of unsaleable bacon, due to "seedy" cut, and have a less attractive appearance. This objection does not exist against the half-breds from black sows by a Large White boar.

The breeder who uses crossbreds has a wide choice of breeds. There is no evidence that any particular breed is to be preferred. With

careful selection and correct feeding and management, equally good results can be obtained. The type required for bacon is very well defined, and if this is obtained and maintained, the rest depends entirely on correct feeding and management.

It is maintained by many producers of bacon pigs that the Large White will answer as well as any cross. In using widely unrelated animals, the breeder " out crosses " his sows within the breed in order to obtain the necessary " crossbred vigour ". In this case the selection to type and other vital qualities is as essential as in the case of cross-breeding.

The Best Type of Sow for Crossbreeding.

In selecting sows for the production of baconers, one can readily sacrifice all fancy breed points, but not breeding, and lay more stress on the economic factors such as conformation, fecundity and constitution. Even good nursing ability, apart from a generous milk flow, as evidenced in the not over-laying of piglets, is a feature that must be considered. It is essential that a sow rears at least 8 piglets per litter.

The sow should possess roominess with length and depth, fine bone and evenness in covering throughout the body, quality and breediness in general appearance, with straighth pasterns and good feet. It happens that a sum total of the desired features is often combined in a high degree in individuals and it is possible, owing to the rapidity of growth and fecundity of the pig, to select and establish a strain of valuable stock from a single sow. Pigs are comparatively cheap, and purebred boars should be used.

SELECTION OF BREEDING ANIMALS.

When a farmer has decided what breed or breeds he is going to use, then he comes to a very important phase in pig production, viz., the selection of the proper boars and sows. With the present intense competition one should try to avoid having poor performers in a herd. With dairy cattle to-day an animal is bought on its pedigree, conformation and performance (or the performance of its ancestors and progeny). In many countries systems for measuring the performance of pigs are enforced, and animals are selected on these. They measure three main factors, viz.,

(1) The ability of a sow to rear a large and heavy litter well up to weaning;

(2) the rate of growth up to bacon weights; and

(3) the quality of the final product.

The influence of boars and sows can be determined, and by this means all poor doers are eventually discarded. Such a recording scheme is about to be started in South Africa. At present an animal is bought only on its pedigree and conformation. The man who does his own breeding is in a better position to select good performers if he keeps a record of the pigs. This means the keeping of breeding records of individual animals, and taking of weights of pigs at least at weaning and again at about 6 months of age.

In the first instance a breeding animal should have excellent health and good conformation. There are several external characteristics which are good indications as to the health and constitution of an animal. The hair shoud have a healthy appearance and be of the right colour, the eyes should be bright and full of life, and there should also be good blood circulation at the extremites such as the ears, tail and feet. In white pigs the skin should have a pinkish colour, and should not be dry,

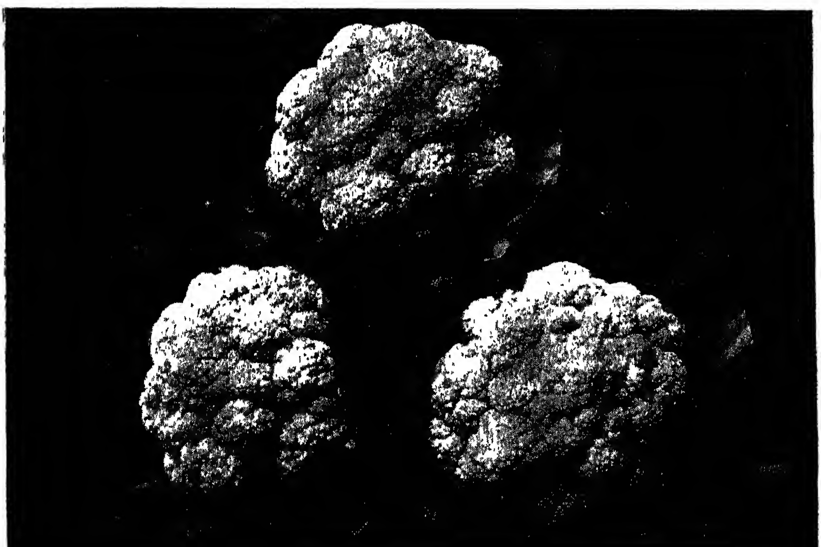
[Continued on page 674.

Cauliflower and Broccoli.

H. B. Terry, Professional Officer, Division of Horticulture, Pretoria.

THE cauliflower is an important vegetable for home and market gardeners alike. Its season of maximum growth is during autumn and winter. Cauliflower is a difficult crop during summer when temperatures are high, and plants become infested with cabbage aphis which necessitates frequent spraying for control. In the Transvaal low-veld the crop should be grown only during the winter months, using early-maturing varieties. On the highveld, under normal winter conditions, the plants can withstand frost for lengthy periods.

Cauliflower can be grown successfully on a variety of soils, but the plants grow best in a fertile clayey loam soil, rich in humus. Lime is an important factor in cauliflower soils, and unless the soil already contains sufficient lime, it will be necessary to apply agricultural lime some weeks before manure and fertilizers are added. Growers are advised to forward samples of soils intended for cauliflower production to the nearest College of Agriculture for an acidity test; they will then be advised as to the amount of lime necessary for their soils, since lime must be ploughed



Southern Cross.

into the soil *and not applied as a top-dressing*. To ensure that the crop will reach maturity, apply 20 tons kraal manure or compost, according to soil fertility, *plus* 300 lb. superphosphate and 300 lb. rock phosphate; or, since artificial fertilizers are difficult to obtain, use 1,000 to 1,200 lb. of either fertilizer mixture D or E per morgen, which should be ploughed into the soil some time prior to transplanting. This will enable the plants to develop good heads without slowing down in growth. If, however, growth is not satisfactory after a few weeks, a side dressing of nitrate of soda could be given, followed immediately by a good irrigation. An adequate supply of irrigation water is absolutely essential where the rain-

fall cannot be depended upon. Light irrigations are useless as they tend to encourage the formation of a shallow root system. Each application of water should be so given that it will reach the root zone. Early varieties include Snowball, Early London, Gilt Edge and Early Italian Giant. Mid-season varieties are Reliance and November Heading. Late varieties are Southern Cross, Late Metropole and Late Italian Giant.

On account of abnormal conditions, the choice of varieties is somewhat limited. Early and second early sorts are scarce, but there is an abundance of late cauliflower seed available in the Union, particularly Southern Cross, and a suitable mid-season variety of which seed is available from local sources, is Reliance.

The Seedbeds.

For commercial production, seedbeds should be prepared in rich soil containing a fair percentage of sand to prevent "caking" of the soil. These beds should be 4 feet wide to facilitate weeding. Sow the seed in drills about 6 inches apart; do not sow too thickly as the seedlings will become too spindly. Cover the drills with approximately half an inch of sandy soil, firm the soil, and water carefully but thoroughly, keeping the soil moist until the plants are removed to their permanent quarters 6 to 8 weeks after sowing.

Seed.—To obtain sufficient seedlings to plant a morgen, one pound of good seed is required. This provides for a surplus over requirements, which may be used for replacements.

When to sow.—Where the crop is grown commercially it is important that the different varieties should be sown at the proper time. This may vary slightly according to the district. *Under highveld conditions* sowing for the autumn and winter crops is done from the middle of November for the earlier varieties, until early January for the latest varieties. *Under lowveld conditions* sowings are made of early varieties in December-January.

It is always advisable to practise some system of crop rotation. Cauliflower disease, as well as insect pests, accumulate in the soil and attack and injure succeeding crops in increasing severity. A good rotation would be; early potatoes, tomatoes, cauliflower; or early potatoes, green mealies or beans, then cauliflower.

Transplanting, Trimming and Spacing.

Assuming that the soil has been well prepared, commercial growers may decide that, in order to ensure adequate and quick irrigation, furrows may be drawn at regular distances with a light plough in the direction which will give the minimum fall, and the plants set in position with dibbers. Transplanting should be done when the seedlings are 6 inches high; if left longer in the seedbed, their growth may be checked, resulting in imperfect heading.

Better results are obtained if the furrows in which the plants are to be set out are irrigated before and immediately after transplanting. Where possible, it is best to transplant during cool, overcast weather. Before the seedlings are lifted, the seedbeds should receive a good watering; after sufficient have been pulled, the plants are trimmed by removing a portion of the leaves to reduce loss of water; the roots, if long, may be shortened slightly. The plants are packed in field boxes and covered with wet bags. For early-maturing (4 months) varieties, the rows should be 2½ feet apart and the plants 2 feet in the rows. For later and larger varieties the spacing should be 3 feet by 3 feet.

Cultivation.—After planting, shallow cultivation should be practised, since many of the roots grow near the surface and these may be destroyed if the cultivation is too deep. Weeds should be kept down at all times and cultivation discontinued when it is impossible to do this work without injuring the plants.

The market requires a white head. To prevent discolouration, the outer leaves are bent over the head for 7 to 10 days (depending on the weather conditions). If growth is rapid, the heads should be examined every few days, and all that have reached the proper stage of development are cut, trimmed and disposed of. It is generally considered a better policy to disregard size at the time of harvesting and to concentrate on the stage of maturity.

Over-mature heads are indicated by the branching of the "flower" or "curd". In the late-maturing varieties a spell of warm weather, just when the heads are forming, may cause the "flower" to become discoloured and loose, while green leaves often develop in the head.

Broccoli.

Broccoli resembles cauliflower; it is, however, much hardier and particularly suitable for very cold districts. Where cauliflower fails owing to frost, broccoli survives and provides excellent heads. The fact that broccoli can be had during late winter and spring, when vegetables are scarce, adds to its value. The crop prefers a clayey-loam soil type of moderate fertility; a heavily manured soil has the tendency to stimulate luxuriant succulent leaf-growth, which may be checked by a period of severe frosts; poor soils, on the other hand, are useless.

There are several excellent varieties of broccoli for winter and early spring use. Sowing during the last week of November is recommended. The most serious diseases of cauliflower and broccoli are black rot and downy mildew. The important insect pests are aphids, cabbage moth, Bagrada bug and cutworms.

A New Venture of the Department

[*Continued from page* 644.

It is hoped that in time the Natal Agricultural Research Institute will take its place alongside the other technical institutions of the Department, and carry its full share of the burden of agricultural investigation, so fundamental to the development of a stable farming industry of the future.

(Dr. A. R. Saunders, Director of the Natal Agricultural Research Institute, Pietermaritzburg.)

A New Bulletin.

Bulletin No. 284. The Feeding of Farm Animals (1. Dairy Cattle) has been published recently. It is obtainable from the Editor of Publications, Pretoria, at 3d. per copy.

Lamsiekte (Botulinus) Vaccine.

IN many parts of South Africa, carcaces of domestic animals, game, birds, tortoises, snakes, etc. which are allowed to rot on the veld, become very poisonous to stock, particularly to cattle. The poison or toxin causes a paralysis which is often followed by death. This is the disease known as *lamsiekte or gallamsiekte or botulism.* Sheep, goats and equines may also develop lamsiekte, but other domestic animals are relatively insusceptible.

Cattle, the most frequently affected of the domestic animals, do not normally eat bones or meat from carcases. However, if the grazing is *deficient in phosphorus*—as is the case in many parts of South Africa—cattle develop a craving for phosphorus and try to satisfy this craving by eating old bones. In this way they swallow the lamsiekte toxin and contract the disease. Pregnant and lactating cows which require extra phosphorus for their young, are the worst cravers for bones and stand the greatest chance of contracting lamsiekte. Horses and dairy cows sometimes get lamsiekte from fodder in which rats or other small animals have died and rotted.

The deficiency in phosphorus can be corrected *by feeding phosphates or sterilized bonemeal.* However, this does not always entirely cure the craving for bones. There may also be difficulties in the way of obtaining sufficient bonemeal. The vaccine against lamsiekte is meant for such cases.

Dose: For large stock (cattle and horses, calves and foals), 5 c.c. for each inoculation injected subcutaneously. For small stock (sheep and goats), 2½ c.c. for each inoculation injected subcutaneously.

(*Packing:* 2, 6, 10, 20 and 50 dose bottles.)

N.B.—*The vaccine must be thoroughly shaken before and during use to suspend the sediment which carries the immunizing agent. It is preferable to order sufficient vaccine for one injection only and to arrange for the vaccine for the second injection to be sent about* 14 *days before it is to be used.*

At least *two inoculations,* with a six weeks' interval between, must be given. The intervals given may be lengthened, but should not be shortened. Animals must be re-inoculated annually, but only a single dose of 5 c.c. is required. The vaccine will only give protection against the true lamsiekte caused by the toxin from carcases.

It cannot be sufficiently emphasized that bonemeal feeding is still vitally important. Immunization against lamsiekte will protect animals against the toxin from carcase material, but cannot cure a phosphorus deficiency. Such a deficiency results in reduced growth, poor condition, low fertility, low milk yield, stiff-sickness (stywesiekte) and lowered resistance to infections.

General.—Great care is taken in preparing the vaccine, and every batch is tested before issue. However, no guarantee is given regarding its safety or efficacy.

Important Notice.—Please note that no refund will be made or credit allowed for any vaccine returned. Such vaccine is always destroyed. Customers will be charged for unclaimed C.O.D. parcels. To avoid delay and annoyance do not order C.O.D. if you can possibly avoid this. Preferably send cash with order.

(Director of Veterinary Services, Onderstepoort.)

Absorption of Phosphorus by Citrus Trees.

Effect of Ammonium and Nitrate Nitrogen.*

A. J. van der Merwe, Division of Horticulture, Pretoria.

THE nitrogen-phosphorus relationship and its influence on the quality of citrus is an important practical problem, which continues to enjoy the attention of workers.

Various investigators have observed that inverse relations exist between nitrogen and phosphorus, but no basic understanding of this problem has as yet been achieved.

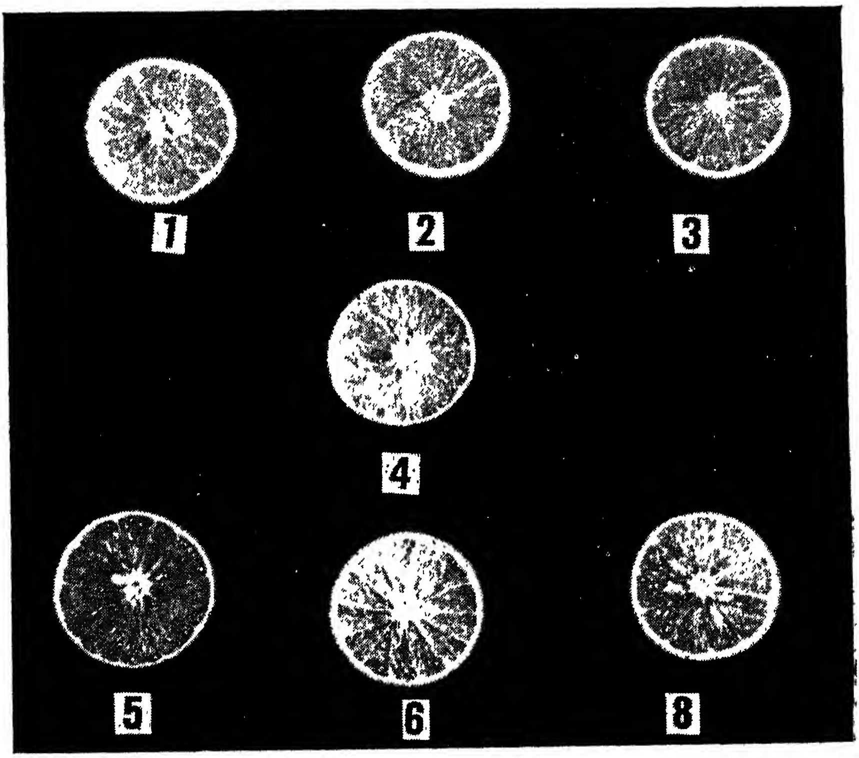


FIG. I.—Effect of two forms of nitrogen on the quality of citrus fruit.

(*a*) Valencia which received nitrogen in the form of ammonium sulphate, produced coarse fruit with a thick rind. (See 1, 2 and 3.)

(*b*) Valencias which received nitrogen in the form of sodium nitrate produced solid, smooth fruit with a thin rind. (See 4, 5, 6 and 8.)

Although extensive research work has been undertaken, the results, however, have provided little information concerning the relative effects of ammonium and nitrate nitrogen upon the absorption of phosphorus under orchard conditions, when applied on a comparable basis to a soil in which the acidity had developed sufficiently to prevent or seriously retard nitrification.

* This is merely a general summary. A detailed treatise will be published later in bulletin form.

A comprehensive study on the absorption of phosphorus in water cultures has brought to light significant facts. It became evident that the mode of phosphorus absorption differed in trees receiving ammonium nitrogen and those receiving nitrate nitrogen.

In view of these findings, it was decided in 1946, to investigate certain fertilizer treatments which had been in progress since 1939, in order to ascertain the possibility of determining any direct or indirect connection between the form of nitrogen and the absorption of phosphorus under orchard conditions.

Fertilizer Treatments.

The following is a description of the treatments applied to compare the two forms of nitrogen:—

Treatment:

1. Ammonium sulphate + potash (Phosphate in the form of super applied for the first time in 1945.)
3. Ammonium sulphate + super + potash.
5. Ammonium sulphate + double super.
7. Sodium nitrate + double super + slaked lime + magnesite.
9. Sodium nitrate + double super + magnesite.
11. Sodium nitrate + double super + slaked lime + magnesite. (Zinc, boron and copper salts applied in 1939).

In all these treatments, nitrogen and phosphate were applied on a comparable basis. In 1946 and 1947 the amount of nitrogen was 2 lb. of ammonium sulphate and 2 lb. 10 oz. of sodium nitrate. Phosphate applications consisted of 2 lb. of super and 1 lb. of double super for the years mentioned.

RESULTS OF FERTILIZER EXPERIMENTS.

Total Nitrogen and Phosphorus content of Fruit and Leaves.

The total nitrogen and phosphorus content of the fruit and leaves for each of the three varieties is given in Table 1.

The data in this table clearly indicate that notwithstanding the fact that nitrogen was applied in equal quantities, there were marked differences in the total nitrogen content of the juice and leaves in all the plots receiving nitrogen in the ammonium or nitrate form. The nitrogen content of the juice of the three varieties was found to be higher in the ammonium treated plots than in the nitrate plots.

In general, the differences in pulp and rind were not as clearly perceptible, except in the case of Valencia, which showed such differences during the 1946 season. Furthermore, it may be noted that the differences in juice of Valencia, were more marked in 1946 than in 1947. This may possibly be due to seasonal variations.

Leaf analyses further indicate that the total nitrogen content of the three varieties is much higher after treatment with ammonium than with nitrate nitrogen.

A surprising feature emerging from these results is, that in the case of Navel and Bailidge Early, nine and twelve months respectively had elapsed since the nitrogen had been applied to the trees, and still the leaf samples from the ammonium treated plots showed a much higher nitrogen content than the nitrate plots. It might be mentioned that although the results obtained from the Valencia plots are in close agreement with those

of the Navel and Bailidge Early, the possibility exists that the results may have been influenced by the fertilizers applied in July 1946 and 1947, whereas the fruits and leaves for analysis were only picked during October for the respective years.

TABLE I.—*The effect of nitrate and ammonium nitrogen applications to the soil on the total nitrogen and phosphorus content of fruit and leaves.*

Naval, Bailidge Early and Valencia varieties (in parts per million).

Treat-ments No.	Form in which N applied.	Navel. 1947.		Bailidge Early. 1947.		Valencia. 1946.		Valencia. 1947.	
		Totals N	Totals P	Totals N	Totals P	Totals N	Totals P	Totals N	Totals P
		p.p.m. in juice.							
1		756	58·5	800	56·3	783	65·2	952	45·6
3	NH_4-N	700	57·4	868	47·2	817	78·3	868	60·8
5		677	56·9	812	68·7	737	66·7	924	63·7
7		602	80·5	728	79·9	700	104·0	840	86·5
9	NO_3-N	574	72·7	728	86·6	677	107·2	840	81·0
11		588	70·6	756	82·1	700	98·7	924	79·0
		p.p.m. in Pulp on oven dry basis.							
1		10,550	594·0	9,100	571·4	10,267	671·6	11,900	476·2
3	NH_4-N	10,850	631·6	9,100	629·0	10,383	668·3	10,675	561·8
5		9,975	674·2	9,100	746·3	10,500	842·3	10,850	555·6
7		10,150	833·3	7,700	779·3	8,400	937·9	10,500	744·0
9	NO_3-N	10,500	1,000·0	8,400	789·5	9,800	932·7	10,675	777·2
11		10,500	759·9	9,100	810·8	8,633	902·3	10,500	704·2
		p.p.m. in rind on oven dry basis.							
1		8,400	114·9	9,100	246·3	8,267	346·8	8,050	276·5
3	NH_4-N	8,050	140·9	9,800	308·6	8,867	354·9	7,700	289·9
5		8,750	151·5	8,400	250·0	9,100	369·0	8,050	255·4
7		7,350	235·3	8,750	375·0	7,700	502·1	8,400	294·1
9	NO_3-N	8,050	266·7	9,100	398·6	7,933	460·6	8,750	275·8
11		9,275	243·9	7,700	348·6	8,167	489·9	8,750	292·7
		p.p.m. in leaves on oven dry basis.							
1		32,200	930·2	31,500	740·7	*—	*—	25,200	384·6
3	NH_4-N	29,050	869·5	29,050	740·7	—	—	23,100	377·4
5		27,650	888·8	23,800	833·3	—	—	22,050	357·1
7		24,850	888·8	21,000	1,000·0	—	—	20,300	481·9
9	NO_3-N	26,250	869·5	21,700	952·4	—	—	21,700	526·3
11		25,200	930·2	21,700	888·8	—	—	19.600	476·2

* Total N and Total P not determined in 1946.

Table 1 shows clearly that the total phosphorus content of the various parts of the fruit and leaves was lower in the plots treated with ammonium nitrogen than in those treated with nitrate nitrogen.

On the whole, therefore the results point to a reduced phosphate absorption in the plots treated with ammonium nitrogen and an increased phosphate absorption in those treated with nitrate nitrogen. It may be as well to re-emphasize here, that the total phosphates applied to all treatments were also calculated on the same basis, the only difference being the form in which the phosphates were applied, namely in the super and double-super form.

Nitrogen- Phosphorus relations.

The nitrogen-phosphorus relations in fruit and leaves as well as the average number of fruits per treatment in 1946 and 1947, in respect of each of the three varieties are given in Table 2.

TABLE II.—*Ratio of total nitrogen* (N) *to total phosphorus* (P) *in fruit and leaves, and the average number of fruits per treatment* (*Navel, Bailidge Early and Valencia*).

Treatment No.	Form o N applied.	Navel 1947.	Bailidge Early. 1947.	Valencia. 1946.	Valencia. 1947.
		N/P ratio in juice.			
1	NH_4-N........	12·9	14·2	12·0	20·9
3		12·2	18·4	10·4	14·3
5		11·9	11·8	11·0	14·5
7	NO_3-N.......	7·5	9·1	6·7	9·7
9		7·9	8·4	6·3	10·4
11		8·3	9·2	7·1	11·7
		N/P ratio in pulp.			
1	NH_4-N.........	16·7	15·9	15·3	25·0
3		17·2	14·5	15·5	19·0
5		14·8	12·2	12·5	19·5
7	NO_3-N.........	12·2	9·9	9·0	14·1
9		10·5	10·6	10·5	13·7
11		13·8	11.2	9·6	14·9
		N /P ratio in rind.			
1	NH_4-N.........	73·1	37·0	23·8	29·1
3		57·1	31·8	25·0	26·6
5		57·8	33·6	24·7	31·5
7	NO_3-N.........	31·2	23·3	15·3	28·6
9		30·2	22·8	17·2	31·7
11		38·0	22·1	16·7	29·9
		N/P. ratio in leaves.			
1	NH_4-N.........	34·6	42·5	—	65·5
3		33·4	39·2	—	61·2
5		31·1	28·6	—	61·7
7	NO_3-N.........	28·0	21·0	—	42·1
9		30·2	22·8	—	41·2
11		27·1	24·4	—	41·2
		Average number of fruits. 1946 and 1947 seasons.			
1	NH_4-N.........	132·5	168·5	248·0	
3		129·0	255·5	305·0	
5		170·0	219·5	286·0	
7	NO_3-N.........	177·0	337·5	373·0	
9		202·5	319·5	408·0	
11		212·5	278·0	395·5	

This table shows that the different parts of the fruit and the leaves of each variety on the plots receiving ammonium nitrogen, produced a far higher nitrogen-phosphorus ratio than those on the plots treated with nitrate nitrogen. This means, that nitrogen in the nitrate form is more

conductive to the absorption of phosphate by trees than ammonium nitrogen, and consequently a bigger crop is obtained, as can be seen from Table 2. Although the data are not presented, the quality of fruit was also far superior (see fig. 1).

Discussion and Conclusions.

The data, as given in Table 1, show that the fruit and leaves of trees receiving their nitrogen in the form of ammonium sulphate, contains more nitrogen than the fruit and leaves of trees receiving nitrogen in the form of sodium nitrate. This finding confirms the results obtained by various research workers in different plants. In contrast with this, results show that in the application of these two forms of nitrogen the total phosphorus content was lower in the ammonium than in the nitrate treatments. The total phosphorus content is, therefore, directly or indirectly affected by the different forms of nitrogen.

Anderssen (1), who used ammonium sulphate as the only source of nitrogen in his experiment, reported the marked effect of nitrogen on depressing the amount of phosphorus in the juice of Naval oranges. The more nitrogen present in the orange juice, the lower is the phosphorus concentration of the juice. In view of the recent results obtained by the author on the detrimental effect of ammonium sulphate on acid citrus soils, the marked effect obtained by Anderssen may be explained in the light of the foregoing results that the higher nitrogen content obtained by Anderssen is a direct result of the ammonium sulphate application to the soil, and the low phosphorus content, an indirect result of the effect of ammonium sulphate on the soil, or a slower absorption of phosphate.

In the study of a high and low concentration of nitrate nitrogen and phosphorus in sand cultures, Pont (4), working on rough lemon seedlings with the main object to confirm or disprove the existence of an antagonism between nitrogen and phosphorus, pointed out in a summary of his findings, that no negative correlation between nitrogen and phosphorus could be determined in the leaves, stems or roots, after nitrate nitrogen had been applied. The above-mentioned tables show that a large amount of phosphate was absorbed when nitrate nitrogen was applied without any abnormal conditions arising. The findings of Pont (4) as well as those of Chapman and Liebig (3) have therefore been confirmed.

Anderssen and Bathurst (2)stress the probability of the nitrogen-phosphorus relations being an important factor in determining the size of the crop. It is evident from Table 2 that the various parts of the fruit and the leaves in each of the three varieties on plots receiving nitrogen in the form of ammonium sulphate produced a much higher nitrogen-phosphorus ratio than those on the plots receiving nitrogen in the nitrate form.

If the conclusions of Anderssen and Bathurst are correct, it would appear therefore, that, on the whole, the only means of producing increased yields from a particular soil type which had been treated with ammonium sulphate only, would be to apply even larger quantities of phosphates. It is doubtful, however, whether such a practice could be regarded as economical.

In view of the author's findings, the following may be an explanation of the positive and negative correlations in regard to nitrogen-phosphorus relationships as determined by various research workers.

(*a*) Positive correlations may be obtained when nitrogen in the nitrate or ammonium form is applied together with sufficient quantities of phosphates, and where soil acidity and impeding fixation and nitrification in the soil do *not* constitute limiting factors.

(b) Negative correlations become evident when (i) nitrate nitrogen is applied together with insufficient quantities of phosphate, or (ii) nitrogen is applied in the form of ammonium sulphate together with sufficient quantities of phosphate, with the result that the acidity in the soil, especially in sandy soils which are poor, might eventually develop to a degree sufficient to prevent or seriously retard nitrification. The plants are thus forced to absorb their nitrogen in the ammonium form, with the ultimate result of a high nitrogen and a low phosphorus content in the fruit.

Summary.

Fruit and leaves of trees receiving different fertilizer treatments, were analysed for total nitrogen and phosphorus content.

The results confirm the findings of various research workers that plants receiving nitrogen in ammonium form have a higher total nitrogen content than plants receiving nitrogen in the nitrate form.

The total phosphorus content of the various parts of the fruit and leaves on plots treated with ammonium nitrogen, was found to be lower than that of the plots treated with nitrate nitrogen.

Notwithstanding the fact that phosphates were applied on a comparable basis, higher nitrogen-phosphorus ratios were determined in the juice, pulp, rind and leaves on plots treated with ammonium nitrogen than on those treated with nitrate nitrogen.

Possible explanations are given for the positive and negative correlations as determined by various research workers.

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Pig Production :—

[*Continued from page* 664.

hard and very white; the latter indicates absence of sufficient blood. Hair without any lustre and a pale colour of the mammary glands and scrotum are indications of poor health, and such animals should be discarded.

For a good conformation, the breeding animal should show firmness and compactness with medium feeding. Soft and over-developed pigs are not suitable—they are usually the animals with very short and deeply dished heads. One should see that the skin is firmly drawn over the body, without wrinkles, and have a good covering of hair also between the front legs and over the hams at the back and the sexual organs. Glossy smooth hair is an indication of good feed utilization. Soft, thick, flabby ears and weak pasterns are bad signs. Next to breeding, rearing and management influence the health and the body build markedly, and should be given proper consideration in producing breeding animals e.g. feeding rations that produce growth rather than fatten, enough exercise, etc.

The Composition of City Milk in Cape Town.*

S. Bakalor, Dairy Section, Agricultural Research Institute, Pretoria.

CAPE TOWN is the second largest market for city milk in the Union. This milk is produced under winter-rainfall conditions, whereas the bulk of the Union's production takes place in the summer-rainfall area.

For these reasons it was decided to make an investigation of the milk supplies of this city. Through the courtesy of the Medical Officer of Health, Cape Town, all the records of the composition of official samples taken by the City Health Department during the period January 1934, to December 1947, were made available to this Institute for statistical study. These records did not give results on the composition of milk analysed prior to this period.

The mean composition of the 6,369 samples, analysed during these fourteen years was:—

Total Solids.	*Fat.*	*S.N.F.*
12·37%	3·67%	8·70%

Deficiency in fat was found in 8·4 per cent. of the samples, whereas 16·5 per cent. tested below the 8·5 per cent. standard for S.N.F. These results appear to be better than those found for other centres.

When the long-term trends in the composition were determined, a rise in both the fat and S.N.F. contents of the samples up to about 1937, followed by a decline to the end of the period of study, was found. This general decline in solids content during later years is further reflected in the fact that the highest percentage of samples analysed per annum which were deficient in fat (16·15 per cent.) occurred in 1945, whereas the highest amount of S.N.F. deficiency (37·98 per cent.) occurred in 1946.

In discussing the causes of this apparent decline in the chemical quality of this milk, it must be remembered that city markets have, during the past twenty years or so, been demanding a larger and larger volume of supplies, owing to the big increase in the urban population. Thus, during the eight years 1939 to 1946 (inclusive), the production of farmers supplying the Cape milk market increased by over 23 per cent. The South African city milk supply demands milk of fair compositional quality, that is to say, milk which, when subjected to periodic official testing, will not result in the prosecution of the purveyor. With public health control and check testing at larger milk plants, quality cannot be ignored, but the demands of the trade make producers concentrate on quantity.

The fact that much of this milk production takes place on expensive land near to cities, intensifies this striving for higher yields. Even though the expansion of the residential and industrial areas of the Peninsula have shifted the main centres of milk production further away from the city, it is found that from 25 to 30 per cent. of the Cape producers still

* A complete report on this investigation is being published in Bulletin form, under the title " The Cape Town City Milk Supply ".

report that they have no grazing for their cattle. On many such farms or small-holdings, within or near the municipal boundaries, cows are kept in exercise camps between milkings and fed almost entirely on purchased feeds.

To offset the high production costs, potentially high-yielding cattle types are being kept, and it is thus found that about 75 per cent. of the cattle in the "milk-shed" are Frieslands, whereas only 8 per cent. are Jerseys (in both cases mainly Grades). An average of 80 per cent. of the cows in the area are in milk at any time. This is a very high figure.

Whether the tendency, with improved transport conditions, to produce city milk further away from the larger centres will result in any improvement in quality has still to be ascertained. It does appear, however, as if the present market demands are not tending to improve the compositional quality of milk supplies.

Seasonal Variations in Composition.

As was to be expected from previous studies, the S.N.F. content of the milk was lowest in the dry months (February, March) and highest in the third quarter of the year, when rainfall is also generally high. The monthly averages for fat were higher in winter than in summer. This similarity of seasonal changes in fat and S.N.F. in the winter-rainfall area is reflected in the tendency for this milk to increase in S.N.F. as it becomes richer in fat. This confirms previous findings that the lack of relationship between the fat and S.N.F. contents of milk samples in the summer-rainfall area is caused by differences in seasonal trend of these two constituents.

Handling Methods.

About 1 per cent. of the samples tested between 8·3 and 23·0 per cent. fat. These samples which were abnormally high in fat, indicated bad mixing of supplies at some time between milking and analysis.

During the four years 1944 to 1947 a total of 50 samples were found to contain added water. Of these adulterated samples, 56 per cent. contained between 5 and 15 per cent. added water.

Averages for all Cape Peninsula Data.

The summarised results of the analysis of 12,378 samples of Cape Peninsula milk (including the 6,369 samples reported on in this article) have now been obtained. Some of these results date back to 1894. The mean composition of these 12,378 samples is:—

Total Solids.	*Fat.*	*S.N.F.*
12·41%	3·74%	8·67%

It would appear from these figures that the Cape milk is, on an average, richer in solids, and especially fat, than that of other centres. This is not so reassuring, however, when longterm trends are considered, for it has been shown that this milk has tended to decline in solids content over recent years.

Due acknowledgement for assistance rendered in this investigation is made in the bulletin referred to.

The Control of "Geeldikkop" in Small Stock.

Dr. J. I. Quin, Onderstepoort.

Incidence.

GEELDIKKOP disease appears mainly amongst sheep in the Karoo areas during the summer months (December to March) when extensive grazing on wilted duwweltjies has taken place. The duwweltjies (*Tribulus*) is a rapidly growing annual plant which appears on the veld soon after the early summer rains. As it is the first green succulent of summer grazing, sheep are inclined to eat this plant in large quantities, especially at a time when little else is available on the veld.

A fresh outbreak of Geeldikkop.

Such plants are suddenly rendered very poisonous when, as a result of drought, they receive a set-back and so undergo wilting. In these circumstances outbreaks of geeldikkop may be precipitated and large numbers of animals lost. Wilting of the plants is frequently encouraged by the presence of a small larva in the crown or stems. Many owners erroneously regard this small parasite as the true cause of the disease. Although duwweltjie plants are found all over the Karoo veld, they are especially abundant on overstocked farms, round about kraals and homesteads, and in vleis more than on hard rocky veld. For these reasons outbreaks of geeldikkop can be expected when sheep, and especially hungry animals on trek, are allowed to graze on such poisonous veld, even for a period of a few days only. In its most poisonous form this

plant may be no more than 1 to 2 inches high, in which stage it is brown, wilted and before any tendrils are visible. As soon as the plant becomes dried out to the extent that it can be powdered between the fingers, it has definitely by then lost all its poisonous qualities. Although Tribulus is the most common cause of geeldikkop on karoo veld, a variety of other plants, such as sweet grass (*Panicum laevifolium*) on old lands, can produce the same condition in the grass-veld areas of the Union. Under various local names this disease has also been encountered in several countries overseas, e.g. Australia, New Zealand and North and South America where a wide range of plants, including Tribulus itself, are responsible for the condition.

Symptoms.

While sheep of all ages are affected, it is especially amongst young sheep with white skins, such as the merino, that geeldikkop causes its worst damage. Occasionally goats and even cattle may also be affected.

The first symptom noticeable is that the animals become extremely sensitive to sunlight and therefore try to seek out any shade which may be available to them. Especially the white and unprotected areas of the skin such as the ears, face and lips show severe swelling within a few hours, thus presenting the typical "thick head" appearance. After a few days this watery swelling subsides, while the skin over the ears and face becomes dried out to such an extent that the eyelids and jaws are fixed and thus no longer movable. In this way many animals are rendered blind through bursting out of the eye balls.

As they are not capable of feeding or drinking, sick animals rapidly loose condition. At the same time there is a drying out of the whole body which, in the forestomachs and large intestines, leads to constipation, commonly referred to as "*hardepens*" by farmers. These swellings are not seen in Karakul and Black-head Persian sheep because of the dark pigment in their skins which protects them against the sunlight. Other exposed white parts of the body, such as the tail and legs in the Black-head Persian can, however, show these swellings. In this form it is frequently referred to as "*lyf dikkop*" by stockowners.

The nature and cause of this sensitivity to sunlight has been proved in experiments to be due to a pigment which is formed in the fore-stomachs from the breakdown of the green chlorophyll consumed in plant material. When this pigment is absorbed into the bloodstream, even the minutest amounts immediately render the animal extremely sensitive to sunlight.

Accompanying this swelling of the head, there is a severe jaundice, affecting the whole body, including the skin. As a result of the poisonous plants consumed, the liver of the animal now fails to excrete its normal amount of bile, which therefore accumulates in the blood and is distributed throughout the whole body. Together with the skin lesions, this jaundice forms the main characteristic feature of the disease, which has been so aptly described as geeldikkop (yellow thick head) by the past generation of karoo farmers.

Control of "Geeldikkop".

From the description given of the origin and nature of geeldikkop, it should be clear that we are dealing here with an extremely difficult problem. First of all, there is no possibility of eradicating this plant

(Tribulus) and, moreover, during normal seasons accompanied by a good rainfall, it is a nutritious and palatable plant. As far as is known there also exists no reliable preventive, such as a vaccine or even a curative remedy whereby sick animals can be cured and protected against subsequent attacks of the disease when they are again placed on poisonous duwweltjies veld.

Since geeldikkop must therefore be regarded as a *grazing problem*, it can only be controlled as such and not by a variety of remedies, while the basic cause of the trouble is left out of consideration. Moreover, the incidence of the disease varies with the season, the type of farming, the farm, and even from one paddock to another on the same property.

A chronical case of Geeldikkop—The skin on the face is hard and dry.

To minimise stock losses it is essential that every farmer should pay attention to the following points wherever geeldikkop is known:—

(1) Consider the nature of the rainfall on your farm, especially in the early summer (October—December). If isolated showers of rain are followed by periods of drought during this period, you can expect outbreaks of geeldikkop as soon as the Tribulus plants start to wilt.

(2) Apply a definite system of *rotational grazing* on your farm; that is, allow certain paddocks to be rested while others are being grazed. *Avoid at all costs the trampling out and overstocking of your veld.* If you are in doubt as to the carrying capacity of your veld, consult your nearest extension officer for the necessary advice and guidance in this matter.

(3) Keep your stock away from kraals, homesteads, old lands, vleis, river banks and other places which are covered with duwweltjies and be careful especially of strange hired out veld during the geeldikkop season.

 Continued on page 702.

The Marketing of Eggs and Poultry.

S. H. Fischer, Division of Economics and Markets.

IN order to ascertain the geographical distribution of the production areas of eggs and poultry in the Union, and to obtain a picture of the marketing channels through which these products are funnelled for final consumption, the Division of Economics and Markets during June-July, 1946, undertook a Union-wide study, and the findings of this investigation are briefly discussed here.

The centres visited during this study comprise Johannesburg, Pretoria, Pietermaritzburg, Durban, Bethlehem, Port Elizabeth, East London and Cape Town. At each centre the market and all the wholesalers and agents handling eggs were visited. Data were extracted directly from the records of the firms and the markets. The Bloemfontein and Kimberley data were collected in a similar manner by the Officer-in-Charge of the Branch Office of the Division of Economics and Markets at these centres.

Producing Areas.

In the Cape Province the main producing area lies south of a line drawn from Clanwilliam through Tulbach, Ceres, Montagu, Oudtshoorn, Avontuur, Graaff-Reinet, Somerset-East, Fort Beaufort, Burghersdorp, Maclear and Umtata and ending at Keimouth on the east coast.

Practically the whole of the Orange Free State produces eggs and poultry. The heaviest concentration of production centres being east of the Johannesburg-Bloemfontein main railway line.

In the Transvaal, the principal producing area lies south of a line from Zeerust through Rustenburg, Pretoria, Lydenburg, up to White River. The most intensive producing area fall within the triangle encompassing Randfontein, Pretoria and Springs.

The chief production area in Natal lies east of the line from Port Shepstone linking Ixopo, Richmond, Mooi River, Dundee, New Castle and Utrecht. The Natal South Coast is the main supply area for poultry on the Durban market. A large proportion of the birds arriving on the Durban Municipal Market from the South Coast is owned by natives and is of a good table quality.

The Seasons of Production and Marketing.

The major portion of the Union's poultry is marketed during the period December to April. This is due to the fact that the cockerels bred during July/October are ready for the market as from December to February and that the culling of old laying hens from the flocks takes place from January to April.

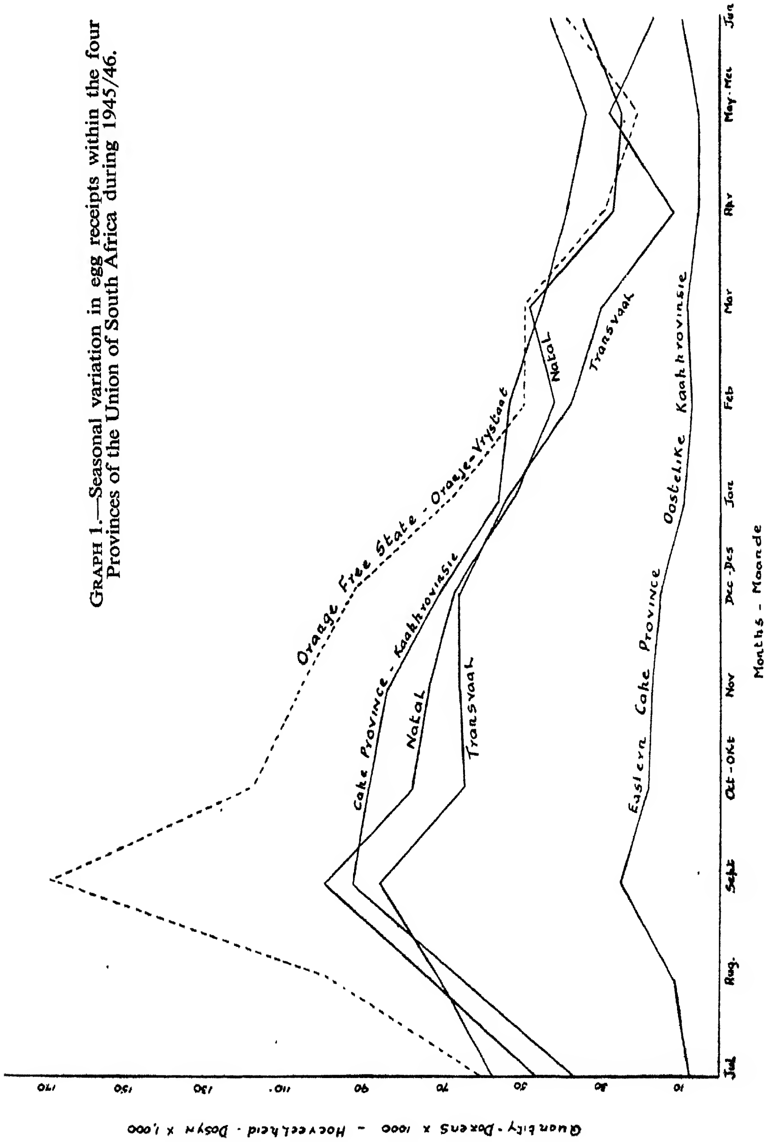
As the demand for poultry by hotels and the high income groups is fairly consistent, the average sales under normal conditions do not fluctuate violently, except for brief periods during the year, such as Christmas time (when the demand for turkeys comes into its own), New Year, Easter and during the celebration of Jewish holidays.

In summary, the following table indicates the months wherein peak quantities of the various kinds of poultry reach the large municipal markets of the Union.

TABLE 1.—*Peak Marketing Months for Various Kinds of Poultry.*

Kind of Poultry.	*Peak marketing months.*
Fowls	March, April, May..
Ducks	February, March.
Turkeys	June, July.

From June onwards stocks of turkeys, fowls, and ducks are built up in cold storage for the heavy demand during Christmas and New Year.



GRAPH 1.—Seasonal variation in egg receipts within the four Provinces of the Union of South Africa during 1945/46.

TABLE 3.—*Quantity of Eggs Marketed by Producers and Country Traders through the Main Distributive Trade Channels during 1945*

Eggs.

In general, the plentiful season of egg production in the Union starts from the beginning of July and extends till December. For all provinces, September appears as the month of greatest egg production.

There is, however, no exactitude about the month of peak production for each province. It may vary from year to year, depending on the climatic conditions immediately preceding September. When a late season occurs, peak production may materialize between the middle of September and middle of October. On the other hand, it may even be as early as August for the Transvaal.

Graph 1 shows the seasonal variation in supplies received directly from producers by representative distributors within the four provinces during 1945-46, and serves to illustrate the cyclical quantitative variation of egg production within each province.

From this graph it appears that production declines for all provinces as from September till May, except for the Transvaal where the May supplies exceed those of June. The increase of supplies during March for the Orange Free State, Natal and eastern Cape Province is partly due to the hoarding of eggs by producers and country traders during the previous month in order to benefit from the expected price increase in March. The increase during May and December in the Transvaal is to a large extent similarly explained.

Marketing Centres.

For the Cape Pronvince, the main marketing centres are Cape Town, Port Elizabeth, East London and Kimberley; and for Natal, Pietermaritzburg and Durban. Producers in the Orange Free State supply the markets at Johannesburg, Bloemfontein, Durban, Pretoria, Kimberley, Cape Town and Port Elizabeth. Producers in Transvaal sell principally on the Johannesburg, Reef, Pretoria and to a lesser extent on the Durban markets.

Distribution of Eggs.

At the most important marketing centres in the Union the wholesalers, municipal markets, agents and egg circles serve as the main arteries along which eggs flow for their final effective distribution. The number of these primary distributors at the various marketing centres is shown in the following table.

TABLE 2.—*Number of primary distributors of eggs at the chief marketing centres in the Union, July 1946.*

Centre.	Mun. Markets.	Wholesalers.	Agents.	Egg Circles.
Johannesburg	1	11	8	—
Boksburg	1	—	—	—
Benoni	1	—	—	—
Springs	1	—	—	—
Brakpan	1	—	—	—
Germiston	1	—	—	—
Pretoria	1	4	8	—
Bloemfontein	1	1	5	—
Bethlehem	—	1	—	—
Durban	1	8	2	1
Pietermaritzburg	1	—	—	1*
Cape Town	1	12	7	1
Port Elizabeth	1	2	4	1
East-Londen	1	—	7	1
Kimberley	1	3	4	—
TOTALS	14	42	45	5

* The Egg Circle at Pietermaritzburg is a depot of the Durban Egg Circle and functions under the Control of Durban.

Province.	Centre.	Municipal Markets.	Wholesalers.	Egg Circles.	Agents.	Retailers.	TOTAL.
		Doz.	Doz.	Doz.	Doz.	Doz.	Doz.
Transvaal	Johannesburg	147,390	7,235,240	—	—	102,700	7,485,330
	Boksburg	13,720	—	—	—	—	13,720
	Benoni	169,990	—	—	—	—	169,990
	Springs	204,249	—	—	—	—	204,249
	Brakpan	268,000	—	—	—	—	268,000
	Germiston	32,000	—	—	—	—	32,000
	Pretoria	554,685	73,390	—	565,144	28,436	1,221,655
TOTAL		1,390,034	7,308,630	—	565,144	131,136	9,394,944
Relative Percentages		14·79%	77·8%	—	6·02%	1·39%	100%
Orange Free State	Bloemfontein	15,725	804,402	—	213,224	—	1,033,351
	Bethlehem	—	906,117	—	—	—	906,117
TOTAL		15,725	1,710,519	—	213,224	—	1,939,468
Relative Percentages		0·81%	88·2%	—	10·99%	—	100%
Natal	Durban	1,628,602	393,399	667,824	532,841	—	3,222,666
	Pietermaritzburg	210,680	—	—	—	15,120	225,800
TOTAL		1,839,282	393,399	667,824	532,841	15,120	3,448,466
Relative Percentages		53·34%	11·41%	19·37%	15·45%	·44%	100%
Cape Province	Cape Town	123,096	2,922,884	713,064	—	—	3,759,044
	Port Elizabeth	168,754	216,204	213,235	534,069	84,443	1,126,705
	East London	137,917	—	468,352	—	—	606,269
	Kimberley	70,689	111,960	—	—	—	182,649
TOTAL		500,456	3,251,048	1,394,651	534,069	84,443	5,764,667
Relative Percentages		8·69%	56·4%	24·19%	9·26%	1·46%	100%
TOTAL FOR THE UNION		3,745,497	12,663,596	2,062,475	1,845,278	230,699	20,547,545
RELATIVE PERCENTAGE FOR THE UNION		18·23%	61·63%	10·04%	8·98%	1·12%	100%

The agents at Port Elizabeth and Bloemfontein do not sell any of the eggs they receive on the municipal markets, but act as wholesalers and retailers in the egg trade. A small quantity of the egg receipts by Pretoria agents is sold on the municipal market, the balance is sold to wholesalers, retailers, hotels and boarding houses direct from their stores. Agents at East London place all the eggs consigned to them on the market. In turn they buy back supplies which they retail or sell at wholesale from their stores. The Johannesburg agents sell the eggs consigned to them partly on the municipal market and mostly to retailers and wholesalers, direct from their stores.

The quantity of eggs handled by the primary distributors during the 1945-46 season, is shown in table 3. The egg receipts of retailers shown in table 3 are for those retailers who obtain their supplies direct from producers. The eggs handled by agents (table 3) are eggs sold otherwise than on the municipal markets listed. The absence of figures for direct sales by agents in Cape Town and Johannesburg is due to the inability to extract the data from their records. It would seem, however, that a considerable portion of their egg receipts is *not sold* on the municipal market.

In the Transvaal, Orange Free State and the Cape Province the wholesalers are the most important primary distributive trade channel, whereas in Natal it is the municipal market. In the nine main urban centres of the Union, about 62 per cent. of the eggs marketed by producers and country traders is handled by wholesalers, about 18 per cent. by municipal markets, about 10 per cent. by egg-circles, about 9 per cent. by agents and about 1 per cent. by retailers. The retailers who purchase directly from producers, handle a considerably larger volume of eggs than shown in table 3, but records are lacking to indicate more fully the volume of their trade in eggs.

An analysis of the source of the eggs handled by wholesalers, who had readily available records, showed that 63 per cent. of the eggs which they handled in 1945-46 came from traders, and 37 per cent. from producers directly. This accounted for 95 per cent. of the total eggs handled by all the wholesalers, as indicated in table 3.

A similar analysis of records of agents revealed that 80 per cent. of the eggs they handled came from producers and 20 per cent. from traders. This accounted for about 54 per cent. of the total eggs handled by agents, as indicated in table 3. The supplies to markets, egg circles and retailers (table 3) came from producers only.

For the various kinds of distributors, as shown in Table 3, the source of supply for 93 per cent. of the total number of eggs handled by them could be accounted for, This showed that 59 per cent. of all the eggs received, came from producers and 41 per cent. from traders.

Poultry.

The bulk of poultry marketed by producers is either disposed of on municipal markets or sold directly to wholesalers, who in turn supply the retail trade and other consumer outlets.

The quantities of live and dressed poultry handled on the principal municipal markets, and the direct purchases of poultry by wholesalers from producers and traders during 1945 are shown in table 4.

Except for the number of live fowls as shown in table 4, the wholesalers handled greater quantities of poultry than those sold on the nine principal municipal markets in the Union. This can partly be ascribed to the cold storage of poultry by wholesalers, the consistent demand of their clients and the identical trend of market and wholesale prices, due to price control at that time.

TABLE 4.—*Quantity of live and dressed poultry handled on the principal municipal markets and by wholesalers in the Union during* 1945.

	Live Poultry (Number.)			Dressed Poultry (lb.).		
	Fowls.	Turkeys.	Ducks.	Fowls.	Turkeys.	Ducks.
Wholesalers.....	1,410,323	529,897	142,785	1,033,149	400,196	109,322
Markets........	1,600,045	69,361	80,035	24,179	1,277	857

Cold Storing.

Poultry as well as eggs require cold storing at certain periods of the year. The cold storing of poultry is required for the short periods of peak demand. While the cold storing of eggs is to make provision for the period when production is low.

Maximum holdings of eggs usually occur in December or January, with minimum holdings in June, July or as late as August. The effect of the time of release of eggs from cold storing will be discussed under prices.

Prices.

The method whereby payment to a producer is effected for eggs marketed, varies with the type of sales channel selected for disposal of his eggs.

Among the various sales channels the following practices were found to be in operation.

(1) Municipal Markets.

At some markets each consignment of eggs received, is graded and sold by grade. Where no facilities for grading exist on the municipal market, the ungraded eggs are sold as Grade 3. The price paid to the producer will then be the market price less commission fees, and where grading is done a charge for grading is levied and deducted from the market price in addition to the commission.

(2) Egg Circles.

The egg circles pay their members on the basis of weight of eggs received. This applies principally to all sizes of 1st grade eggs. The total weight of the various sizes of 1st grade eggs received, is calculated and the amount realized for these 1st grade eggs is paid out on the basis of 24 ounces per dozen.

One of the egg circles deducts certain penalties, should the eggs received be degraded to Grade 2 or Grade 3, which in turn reduces the payment to a Grade 2 or Grade 3 quality basis for such eggs.

Another egg circle accepts only 1st grade eggs from its members. Should there be any other grades, these are sold on the open market for the account of the member, and the egg circle takes no notice of such payments.

(3) Agents.

(*a*) Some agents buy the eggs from producers on their own account. The eggs received are graded and the producer is paid three pence less per dozen than the fixed maximum wholesale price for the grades received.

(*b*) Other agents retail eggs on behalf of consignors and charge 10 per cent. commission on the price realized.

(*c*) Some agents place all the eggs they receive on the market and charge a commission on the price realized for their service.

(*d*) At some centres the agents negotiate egg sales from their stores and do not place the eggs on the market. The price charged is either the ruling market price or a negotiated price between the agent and the buyer. A commission is charged by the agent for this service.

(4) Wholesalers.

Weekly prices are quoted by wholesalers to their clientele. These prices are effected by:—

(*a*) *Season.*—During March, April and May, prices are high, as the supply is small. From middle July to the beginning of December prices are low, as supplies increase.

During the transition period (June/July) wholesalers are not eager to buy traders' eggs, as price control is then less effective and the speculative risk at its peak. During this period prices quoted to traders and producers drop very sharply (see Graph 2).

From July to December is the peak producing season, and eggs are then plentiful. During this period a large percentage of poor quality eggs is received which depresses the price. August and September are usually the cheapest months in the plentiful season, during which period the highest percentage of inferior quality egg is received. During this period prices are further depressed owing to the fact that the firms cannot handle the quantity available and seek to divert supplies. This inability to handle the supplies of eggs available is mainly due to the changed procedure of cold storing.

Previous to control, eggs were stored as received. They were only graded and sized on removal from cold storage. Consequently more eggs could be handled then at present, as the eggs have to be tested, sized and graded prior to being stored.

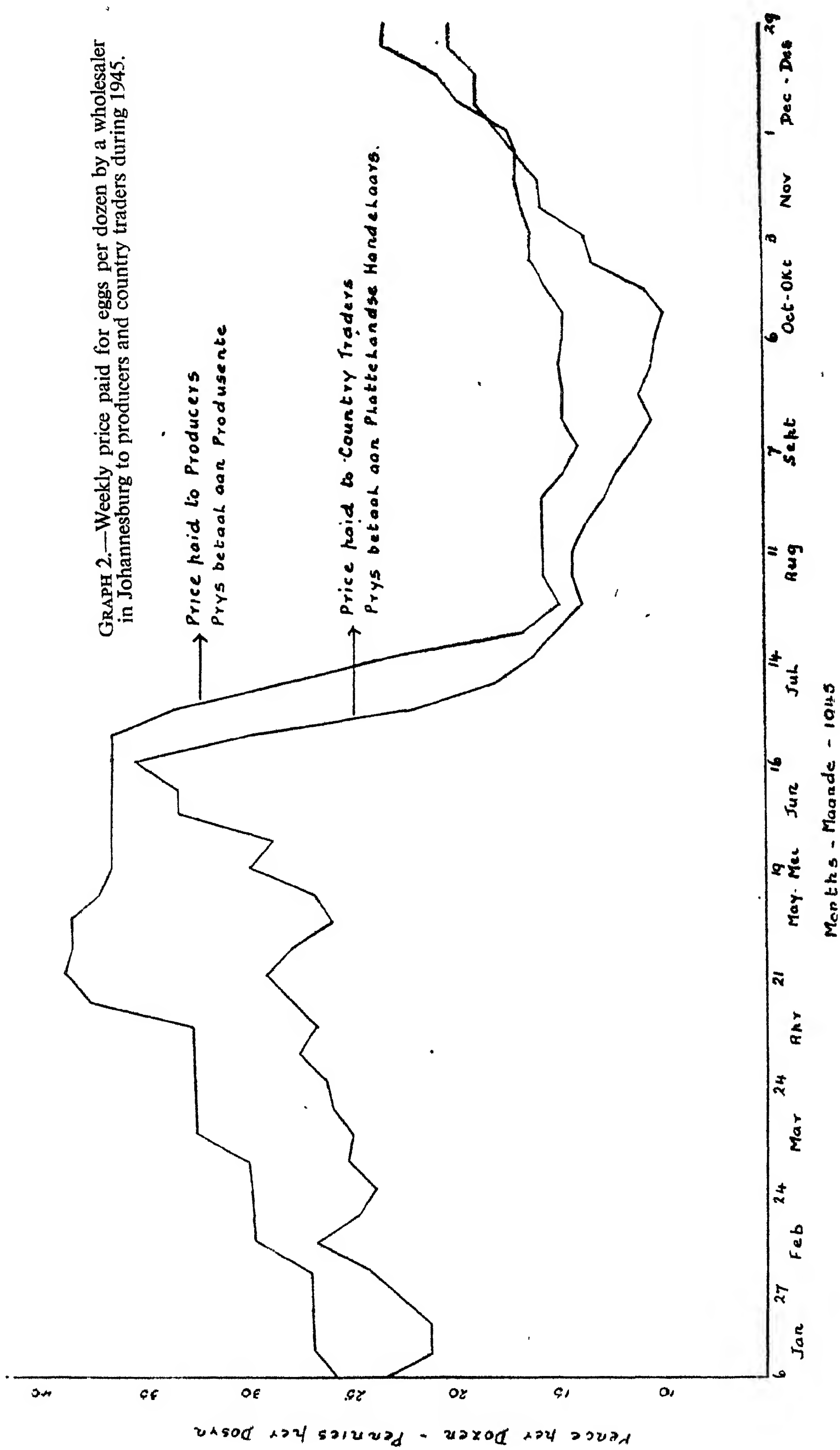
This reduced capacity to handle eggs, also has the effect of forcing some wholesalers to go off the market for periods during the peak season, with the result that prices are further depressed

During February and March, producers and traders are inclined to hoard eggs, so as to gain the expected price increase during April. This actually causes prices to drop in May, as allowance has to made for the large percentage of inferior quality eggs as a result of the hoarding (see Graph 2).

During the season of scarcity, the price of Grade 3 eggs becomes relatively low in comparison with Grade 1 eggs. Moreover, the offal during this period decreases. In addition there is a larger percentage of large and medium eggs. As traders' eggs are classed as Grade 3, their prices are most affected during the season of scarcity. In consequence the price of traders' eggs rises steeply from March to the beginning of June.

(*b*) *Differences in Start of Seasons.*—The plentiful season of the Orange Free State and the Transvaal normally starts earlier than that of the Cape. The Cape wholesalers then immediately purchase eggs in the Free State or Transvaal, thereby causing prices to drop in the Cape in relation to the measure of competition that the wholesalers offer each other.

(*c*) *Provincial Differences in Production.*—The Orange Free State produces more eggs and poultry than it can profitably consume within its own borders. During the peak season the heavy supplies cause the



GRAPH 2.—Weekly price paid for eggs per dozen by a wholesaler in Johannesburg to producers and country traders during 1945.

prices to drop. During this period Cape Town buys in the O.F.S. or even in the Transvaal. This brings the Cape prices in line with those of the other provinces.

(*d*) *Pullet Eggs*.—From January to June, pullet eggs make their appearance. A due allowance is made for these eggs in the weekly price quotation.

(*e*) *Seasonal Influence on Production*.—About the middle of June egg production starts to increase. During July and August the rate of egg production is accelerated, and reaches its peak in September. Thereafter egg production starts to decline slowly till November. From November onwards the rate of egg production declines more rapidly, reaching its lowest point during April or May. During part of May and part of June, egg production is low and remains at about the same level.

Before the war, eggs were exported during the season of plentiful production when prices declined to a level at which export became remunerative.

Soon after the outbreak of World War II, the export of eggs ceased. The Government was committed to supply food to troops and to ensure supplies to the civilian population during the season of scarce production. Price control and the Purchasing Scheme for eggs was introduced. The Government undertook to purchase, during the season of plentiful production, all eggs marketed which were of a specified grade, and size at a previously announced price should the market price fall below the announced price. During the period of short supply, eggs are again released at fixed prices to wholesalers.

The Government also had the sole right to store eggs in all commercial and private cold stores in the country. This buying scheme, which is still in operation, functions under the control of the Director of Food Supplies and Distribution.

The trade, during the pre-war period, made their own storage arrangements to ensure adequate supplies of eggs in order to cover their commitments during the season of scarce production. As a result of the introduction of the Egg Buying Scheme, they are at present dependent upon the Directorate of Food Supplies and Distribution for egg supplies during the scarce season.

During December and January, when the holiday season is in full swing, the demand for fresh eggs increases. During this period, however, the production of fresh eggs has already declined considerably from the peak usually reached in September.

In order to attract sufficient supplies of fresh eggs from producers, the pre-war practise of the trade was to sharply increase the price offered to producers over this period and to supply bakers with eggs drawn from their own cold stores.

Under control, graded price increases are introduced from time to time as the scarce season advances. Moreover, the trade can only draw supplies from cold storage when permitted by the Food Controller.

At present, therefore, the price paid to producers by the trade is governed by the maximum fixed price in operation during this part of the season and not by the demand for eggs over this period.

It is, however, not proposed to discuss here the control problems connected with the cold storage of eggs and the effect control has had on prices, as it is hoped to deal with these aspects in a later article.

Cattle Breeding on Intensive Irrigation Schemes.

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LARGE irrigation schemes have already been established in the Union and further extension is being contemplated by the State. The main object of these irrigation schemes is to harness for food production, our river water flowing fruitlessly to the sea. Irrigation schemes require huge sums of public money; and, consequently the effective application of such schemes is essential. In this discussion the authors propose to confine themselves principally to the success of irrigation schemes in respect of long-term economic agricultural production.

Irrigation schemes, may be classified into two main categories viz. intensive and extensive. The latter type of scheme is aimed at the stabilization of cattle-farming systems in the drier parts of the country, and embraces principally the production of fodder crops to supplement the veld. In the case of the intensive irrigation scheme the income is derived from products derived from a limited area under irrigation and this type of farming is particularly intensive and specialized.

High-grade Friesland Cows on Sudan grass and Babala—Vaalhartz Research Station.

The success of an intensive irrigation scheme is closely bound up with the following: (1) a profitable farming system; (2) maintenance of soil fertility, and (3) stability in the farming system. The type of system to be followed on the irrigation scheme will be determined by such factors as environment, situation with respect to markets, and the aptitude of the settler. Whatever system is followed, it is essential that the income so derived shall meet the necessities of life of the settler and his family. Above all, the income must be consistent, so that the settler need not experience successive periods of plenty and want. Stable farming enables the farmer to plan ahead, and this, in turn, has a stabilising effect on the whole community. The effect of a stable income extends far beyond the mere comforts of the settler—it contributes in no small way to his happiness on the plot, and this will keep him there and so ensure the stability of the entire scheme.

Arbitrary changes in farming systems, to meet the fluctuating prices of products, frequently result in exploitation of the soil, deterioration, and possible ruination for further economic production. It goes without saying that the farming system should be such as to maintain soil fertility. for an indefinite period. All malpractices, such as wrong use of irrigation water, depletion of plant nutrients in the soil, etc., shorten the productive life of the soil. Thus, success in farming on irrigation schemes requires an intimate knowledge of farming methods and careful planning of the systems to be followed.

The farming systems to be followed on an intensive irrigation scheme will depend upon the production of cash crops, i.e., the direct marketing of agricultural crops, or the marketing, wholly or partially, of these crops through the medium of animal products. In the past, some of the schemes were not a financial success, and the Government had to write off heavy commitments in favour of the settlers. As far as is known, cattle breeding played no significant rôle in the farming systems there. By this we do not wish to imply that failure was ascribable to the absence of the cattle breeding factor in the system, but rather that the planning was not based on sound economic principles, as for example, accessibility of markets, size of plots, water supplies, soil fertility, etc.

Rôle of Cattle Breeding.

It is felt that cattle breeding can play an important part on any intensive irrigation scheme planned according to the factors already mentioned, and that cattle breeding should be far more generally encouraged on such schemes. In the first place, farm animals are indispensable to the provision of domestic requirements, and the policy should be for settlers on intensive irrigation schemes to be self-sufficient, especially in respect of protective foods such as milk, butter, etc. Obviously, the number of animals involved in the supply of these requirements is small, and their inclusion in the farming system is therefore a simple matter. Secondly, farm animals may be an important source of income to the settler where the system is so organized that crops are marketed through the animals. It is, however, necessary first to establish whether the income derived from such a system, will be sufficient for the settler's needs i.e., whether it will be as profitable as the cultivation of cash crops. Throughout the world the cow, in comparison with other farm animals, is recognised to be the most economic producer of food for humans.

A Small-farm Dairying System.

As an example of how a dairying system may be organized, and the possible income to be derived from it under intensive irrigation conditions, the following data are given of experiments conducted at the Vaalhartz Agricultural Research Station.

On the basis of information collected over a number of years in crop and milk-production experiments under intensive irrigation conditions, a full-scale dairy farming project was initiated at this research station in 1943 with 30 Friesland cows and one bull on 24 morgen of irrigation land. This project is called the milk-production unit experiment, and its object is:—

(1) To develop an efficient and remunerative system of dairy farming under intensive irrigation conditions, without veld grazing.

(2) To determine what possible income can be expected from this farming system under Vaalhartz conditions; and

(3) To apply the results of research with dairy cows and crops conducted elsewhere at this institution, in actual practice, with a view to the more accurate determination of the problems involved in this form of farming.

The decision to use 24 morgen of land for this experiment is based on the fact that most plots at the Vaalhartz Settlement are 30 morgen in extent. Using 24 morgen for milk production purposes, leaves a few morgen for the house and other buildings, kraals, camps, a vegetable garden and fruit trees, as well as space for the cultivation of other crops like wheat, potatoes and feed for draught-animals, i.e. 6 morgen in all. Since veld grazing on this settlement is limited and most settlers have difficulty in obtaining it, no veld grazing is made available to the animals in this unit experiment.

The 24 morgen of irrigation land are used exclusively for the production of fodder and pasture crops for the herd, and a six-year rotational cropping system is followed with lucerne, winter cereals and Sudan grass or babala.

The area under lucerne is 16 morgen in extent; 8 morgen are put to oats and barley in winter and to Sudan grass or babala during the summer period. The lucerne remains for four years, at the close of which it is ploughed in and followed for two successive years by winter cereals and Sudan grass or babala during summer, after which the area is again put to lucerne. In a definite rotation, four morgen of lucerne are ploughed up annually, while four morgen which have been under Sudan grass or babala, are sown to lucerne again. The lucerne is established during April, with an application of approximately 20 tons of kraal manure, 1,000 lb. of superphosphate and 200 lb. of sodium nitrate per morgen. It also receives an annual top-dressing of 800 lb. of superphosphate per morgen during August. The kraal manure is obtained from the cows in the unit proof. The oats and barley are sown during March and April with an application of 600 lb. of superphosphate and 300 lb. of sodium nitrate per morgen, except when the crop succeeds lucerne, in which case only 600 lb. of superphosphate per morgen are applied. Algerian oats and Victoria barley are sown. The oats and barley are ploughed in from the beginning of September to the middle of October, according to the decline in growth, and replaced by Sudan grass and babala, sown from the end of September and on into November, 800 lb. of superphosphate and 400 lb. of sodium nitrate per morgen being applied at the time of sowing. The following quantities of seed are used per morgen: Lucerne, 40 lb.; Sudan grass and babala, 60 lb. each; oats and barley, 150 lb. each.

The lucerne is cut mainly for hay and fed to the herd in this experiment. The surplus lucerne hay, carried over at the end of each year, is sold. When circumstances do not permit of the making of lucerne hay, the crop is ensiled with 3 per cent. molasses. This lucerne silage is fed during seasons when no summer or winter grazing is available. The lucerne is not grazed, the danger of hoven being too great.

The stubble or residue which is usually wasted on the land after the lucerne has been cut and the hay removed, is, however, grazed for 2 to 3 days after each cutting, when there is no danger of hoven.

The oats, barley, Sudan grass and babala are used exclusively as grazing.

Treatment of Dairy Cows.

Good quality cows are kept in this experiment since the feeds and pastures produced are too valuable and expensive to be fed to animals of inferior quality. Because no veld grazing is available, no calves are reared, and suitable cows or heifers are bought to replace old cows, cows that die, low producers and unproductive cows. Calves born in the herd are sold when they are a week old, as is done in large dairying concerns in and near urban areas. When not grazing or being milked, the cows are kept in two camps (provided with adequate tree shelter) near the milking shed. Cows in milk are kept apart in one camp, and dry cows in calf and the bull in another. In these camps the cattle receive their lucerne hay and silage in hay-racks with mangers, which reduce wastage to a minimum. Water and a salt-and-bonemeal lick are also provided here. As far as possible, the cows are milked for 300 days and served again about two months after calving. Young cows are served about 3 months after calving, in order to give them more time to improve in condition before the next lactation commences. The cows are milked twice a day and at milking time the high producers receive supplementary mealiemeal feed in the byre. This mealiemeal is bought, no maize being produced under the system as yet. The surplus lucerne hay is virtually exchanged for mealiemeal.

Grazing of Crops.

The oats, barley, Sudan grass and babala are, as far as possible, all grazed in the early stages of growth, i.e. when they have reached the height of 9 to 12 inches. In these stages the nutritive value is at its peak, especially for milk-production, and recovery of the plant much more rapid. These pastures are controlled and the amount supplied to the cows restricted in order to ensure that suitable young grazing will always be available during the season. The area under pastures is divided into morgen camps by means of electrical or other temporary fencing and each camp is cropped down within a period of 7 days, after which it is rested to recover for the next grazing period. Continuous grazing of summer and winter pastures has a most detrimental effect on the growth of plants. Considerably more grazing of higher quality is obtained through this system of rotational grazing.

High-producing cows always receive preference on pastures. Dry cows in calf receive grazing only when the needs of the producing cows have been provided for. Shortly after sowing and again at the end of the season when grazing is still scarce, only the high producers are allowed on the pastures, and only for about an hour per day. As more grazing becomes available, the high-producing cows are kept on grazing for longer periods per day and the other cows in milk and later also the dry, pregnant cows, are gradually allowed on pastures. The dry, pregnant cows are usually put on pastures which have first been lightly grazed by the cows in milk; this gives the latter the benefit of the best grazing, the residue being sufficient for the dry, pregnant cows. The crops used in this system make valuable pastures, on which cows can maintain a high level of milk-production with the lucerne supplement they receive. It is, consequently, of primary importance for the success of the farming system that the pastures be used as effectively and economically as possible, especially the winter cereals which cannot make such rapid growth as the summer pasture crops.

Hay Rations.

Cows in milk are taken to the pastures immediately after milking in the morning, and on returning they are given lucerne hay in the camp

racks. The quantity of lucerne hay fed, varies according to the amount of grazing available. When grazing is scarce and the cows are allowed to graze for only one hour per day, they receive an average of 25 to 30 lb. of lucerne hay per cow per day. In the case of cows grazing for 4 hours per day, the average allowance is 18 to 20 lb. lucerne per cow per day. On 8 hours of grazing per day, the cows receive an average of 15 lb. of lucerne hay per cow per day. In addition to lucerne hay, cows yielding 4 gallons of milk per day and more, receive supplementary mealiemeal, according to their excess production. Dry, pregnant cows receive less lucerne hay than the cows in milk, viz. an average of 10 lb. of hay per day when they are on pastures. During the period of transition from winter to summer and again from summer to winter, i.e. from the time when the pastures begin to fail in growth and nutritive value till the next pasture crops are ready for grazing, only lucerne hay or lucerne hay and lucerne silage are provided, if the latter is available. Cows in milk then receive an average of 35 lb. of lucerne hay or 25 to 30 lb. of lucerne hay plus 30 lb. of lucerne silage per cow per day; cows producing more than 3 gallons of milk per day receive a supplementary ration of mealiemeal according to their production. Dry, pregnant cows receive an average of 20 to 25 lb. of lucerne hay per cow per day when they are not on grazing.

Sowing Time for Crops.

The transition period is usually of short duration, since the sowing programme is drawn up with a view to making the interruption of grazing as brief as possible. Sudan grass or babala which is sown during the last week of September or during October, may be grazed after about 46 days, i.e. from the middle of November onwards. Oats, sown during April-May, will yield grazing till October, thus reducing the break to about 1½ months during which no grazing is available at this time of the year. The period of transition from summer to winter is of about the same duration, since oats sown during March will be ready for grazing from the beginning of May, while Sudan grass or babala yields grazing till the end of March. During 1946, for instance, oats and barley were sown on 8 April, 1946 (after the lucerne had been ploughed in) and then grazed from 24 and 26 May, 1946, i.e. 47 and 49 days respectively after the date of sowing. The barley was grazed until 30 September after which it was ploughed in, the soil being sown to Sudan grass and babala on 30 September, 1946, these crops in turn being grazed from14 November, 1946. The oats produced good grazing till 25 October, 1946, when it was ploughed in and succeeded by Sudan grass and babala.

Results Obtained.

This milk-production experiment has already been in operation for 3 years and the results obtained during the third year extending from 1 September 1945 to 31 August 1946 are briefly summarized below:

A.—Milk Production.

	Third year
Experiment period (365 days)	1/9/45 to 31/8/46.
Average number of cows in herd during year	29.8
Average percentage in milk during year	72·5
Average number cows in milk during year	22·8
Total milk production	200.887 lb.
Average milk production per day	55·0 gall.
Average daily milk production per cow in herd	18·5 lb.
Average daily milk production per cow in milk	24·0 lb.
No. of calves born—	
Heifers	14
Bulls	13

Three cows died during the third year.

B.—Feed Production.

	Third year.
Average amount of lucerne hay surplus per year	14 tons.
Seed and fertilizer used per year:—	
Lucerne seed	180 lb.
Oats and barley seed	1,200 lb.
Sudan grass and babala seed	480 lb.
Superphosphate	124 bags.
Sodium nitrate	22 bags

The lucerne yield averaged 9 tons per morgen per year. The lucerne received 8 irrigations per year, and the oats, barley, Sudan grass and babala, 4 to 5 per season.

C.—Consumption of the Herd (cows and bull).

Lucerne hay	243,250 lb.
Lucerne silage	67,790 lb.
Concentrates	14,341 lb.
Bonemeal and salt	1,030 lb.
Cow grazing days of:—	
One hour per day	748
Two hours per day	2,013
Four hours per day	4,607
Eight hours per day	2,164

From the above data it may be deduced that the possible grass income from milk production under this system approximates £1,757 reckoning the price of fresh milk at 1s. 9d. per gallon.

If, as against this, the 24 morgen used for the milk-production unit experiment, is devoted exclusively to the production of lucerne hay for direct sale, the gross income may be expected to approximate £1,680, assuming the price of lucerne hay to be 7s. per 100 lb. and the yield, 10 tons per morgen. Unfortunately there are no data available of the relative production costs of these two systems, so that a comparison of the nett incomes is impossible. Still, the comparison on the basis of gross income furnishes sufficient information to indicate, that, under these intensive irrigation conditions, dairying may be decidedly profitable—provided that facilities exist for marketing fresh milk—even if the production costs constitute 50 per cent. of the gross income.

The figures given above may be considerably improved by an increase in feed and milk production. It should further be realized that in this system cows in milk as well as dry cows, were fed intensively, and that the income may be considerably increased where veld-grazing is available for the dry cattle and the cows in milk are intensively fed.

Dairying, as detailed above, is a most exacting form of farming, in that it requires a high capital investment, and demands mature experience and an aptitude for this type of farming. In the adaptation of cattle breeding, like dairying, to conditions on irrigation schemes, it is clear that the production of cash crops will fulfil a very important rôle initially. The development of a dairying system will necessarily have to be gradual, and, in many cases even assume the character of a diversified farming system where fewer cows are kept and certain crops grown for direct sale.

Fattening of Oxen.

Apart from dairy cows, other farm animals, such as stores, pigs, sheep and fowls may be profitably included in diversified farming systems, provided that conditions are favourable thereto. At the Vaalhartz Agricultural Research Station experiments in fattening oxen on locally grown crops proved successful. Special mention may be made here of an

experiment with oxen in medium condition on wheat grazing only, and on wheat grazing plus lucerne hay. The oxen were well finished for the market while the decrease in grain yield after one grazing was only 7·7 per cent. In this experiment only 0·58 morgen of wheat grazing was used for each ox. Pigs and fowls will always, to a greater or lesser degree, fit into every system, since they supply essential household needs.

Maintenance of Soil Fertility.

So far the practical and economic application of a cattle-breeding system under irrigation has been dealt with, but the farming system practised on intensive irrigation schemes, must be carried out with due regard to the maintenance of soil fertility. One of the most important factors connected with soil fertility is organic material. As soon as the natural vegetation is removed and the soil is cultivated, the decomposition of this organic matter is accelerated. This condition of decomposition is accelerated to a greater extent on irrigated soil which is always kept moist and active. The deterioration in soil fertility resulting from the loss of organic matter under intensive cultivation conditions, can be controlled only by the application of organic matter. Unless adequate provision is made for restoring organic matter to the soil, the inevitable result is the speedy exhaustion of humus to a limit insufficient for normal production and it may even fall so low as to spell total failure. Destruction of the soil structure is coupled with the exhaustion of organic material and has further injurious effects—the application of fertilizer to such soils no longer has the desired effect. Humus, therefore, has functions which make it absolutely indispensable to fertile soil, and its presence, so vital to the fertility of soils on irrigation schemes, cannot be sufficiently emphasized whatever the farming system adopted.

The well-known means for improving the physical properties of soils, is organic matter in the form of farm manure. Where cattle breeding, and especially dairying as described above, constitutes a considerable part of the farming system, provision of such farm manure is very simple. Its value lies not only in the mineral matter or humus which it supplies, but also in the minerals returned to the soil. It has been established that 10 tons of good kraal manure supply 450 lb. ammonium sulphate, 400 lb. superphosphate and 250 lb. potassium sulphate. One cow can produce 15 tons of kraal manure per annum, i.e. approximately 450 tons are obtained from 30 cows—the number used in the above dairying experiment. This quantity of manure is returned to the lands and is part and parcel of farming systems in which cattle breeding is the chief source of income.

Cattle Breeding Assures Stability.

Cattle farming on irrigation schemes not only provides the farmer with the necessary income and maintains the fertility of the soil, but also gives the much-desired degree of stability which everybody looks for in his calling. Since the capital investment is high, and one has to do with expensive animals which one grows to love, the farming system is not arbitrarily changed to meet the demands of the fluctuating market. Consequently, there is no exploitation of the soil as in cash-crop systems, but an effort is always made to derive a maximum income from products. The soil not only passes on to the next generation in a good condition, but most important of all, the farmer makes a sure living. The psychological advantages of good systems of farming are great. Greater variety is obtained in farm work and monotony is avoided. Cattle breeding is pleasant work, and since the farmer is obliged to devote daily attention to this work, it follows that he will utilize his available time effectively

and economically. All this leads to conscientiousness and so ensures success. It is, of course, wrong to encourage the adoption of any farming system for which suitable facilities are lacking, and due regard should be had to the facilities for marketing animal products before large-scale cattle breeding is encouraged in farming systems under intensive irrigation conditions. It is important to remember that the State, in establishing irrigation schemes, aims not only at higher food production, but also at raising a section of our population which has become impoverished as a result of circumstances. The latter aim can be realized only if provision is made for a stable livelihood for such persons, while at the same time care is exercised to avoid exploitation of the soil. The success of farming systems in which cattle breeding plays an important part, will also be intimately related to the natural aptitude of the farmer and his love for farm animals. Due cognizance should be had to this fact, in the selection of settlers. Thorough instruction in the care and feeding of such animals is essential for those selected.

If the various requirements as set out above, are met, cattle breeding will undoubtedly always play an important part in the farming systems on intensive irrigation schemes.

Useful Bulletins.

The following are a few of the bulletins obtainable from the Editor of Publications, Department of Agriculture, Pretoria, post free and prepaid at the prices indicated:—

Poultry Farming.—Bulletin No. 241, by Dr. J. J. Bronkhorst. Price 1s.

Poultry Houses.—Bulletin No. 257, by C. L. Marais and N. J. van Straaten. Price 1s.

Turkeys.—Bulletin No. 264, by E. F. Lombard and Prof. A. M. Gericke. Price 3d.

Classing of Poultry or the Culling of Non-Producers.—Bulletin No. 207, by P. J. Serfontein. Price 3d.

The Small Hive Beetle.—Bulletin No. 220, by Dr. H. E. Lundie. Price 3d.

The Production and Handling of Cream.—Bulletin No. 219, by P. Toens and P. du Preez. Price 3d.

The Preparation of Skins for the Market.—Bulletin No. 263, by P. D. Rose. Price 3d.

Gerbille Control.—Bulletin No. 233, by D. H. S. Davis and A. D. Thomas. Price 3d.

Miscellaneous D.D.T. Studies With special reference to Some Common Agricultural Pests.—Bulletin No. 276. Price 3d.

Uneconomic Vines and Gaps in the Vineyard.

A. H. Malan, Western Province Fruit Research Station, Stellenbosch.

IN the cultivation of the vine there is, generally speaking, considerable scope for improvement in respect of more careful selective propagation, the elimination of uneconomic vines and the filling of gaps in the vineyards—factors which are responsible in some vineyards for a poor and unsatisfactory yielding capacity.

No dairy farmer would tolerate a Friesland cow in his herd which at best produces only a few pints of milk a day; likewise no wine farmer (and we refer more particularly to the table-grape grower) should tolerate vines which from an economic point of view are a liability to him instead of an asset.

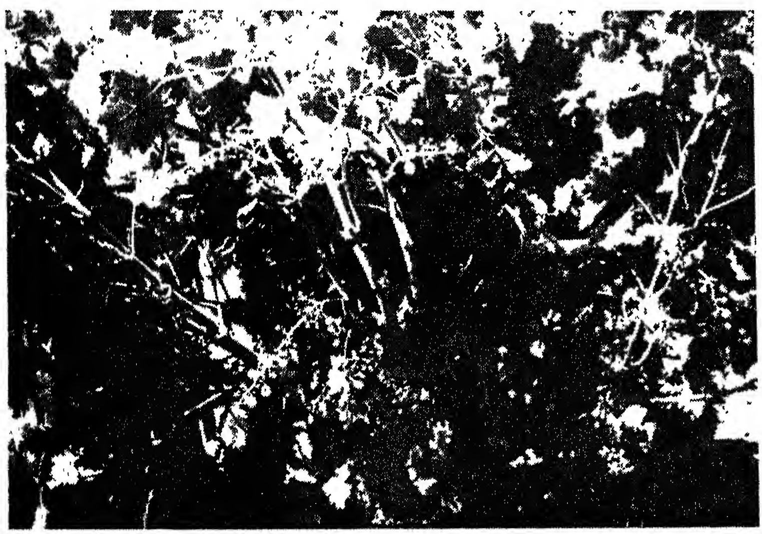

FIG. 1.—A typical example of an uneconomic vine. Notwithstanding its strong vigour, this Hanepoot vine annually produces scarcely anything more than a number of bare stems.

The grower who makes maximum economic productivity his constant aim, will in due course be rewarded, in that plant nutrients and labour which are difficult to procure, will not be wasted on gaps in the vineyards, or on vines not capable of deriving the maximum benefit.

In the nature of things, the improvement of the quality of vine-yards is a comprehensive subject, inevitably embracing all aspects of the culture of the vine. This article is, however, confined to the fundamental requirements, viz.: selective propagation, the elimination of uneconomic vines and the filling of gaps in the existing vineyards.

The cultivation of suitable grape varieties for specific soil types and climatic conditions does not fall within the scope of this article.

Selective Propagation.

By selective propagation is meant the selection of the parent vines for use for grafting or propagation purposes.

A striking feature, especially in grape varieties which are subject to non setting of berries, or which are characterized by the formation of small round seedless berries, is the degree of difference in individual vines. The observer will be struck by the fact that whereas certain vines bear well-developed bunches, others, situated perhaps only a few feet away and equally vigorous, produce no more than a number of bare stems or small seedless berries. (Compare Figs. 1 and 2 with Fig. 3).

Considering that, with the possible exception of small differences in soil, all the vines are grown under practically identical conditions as regards rootstock, fertilization, pruning, topping, irrigation, climatic conditions, etc., the logical and obvious explanation for the aforementioned phenemenon would appear to lie mainly in inherent hereditary differences in the vines themselves.

Fig. 2.—Another example of a hereditary weakness. This Rosaki vine is uneconomic on account of its high percentage of small, round, seedless berries.

Unfortunately, little experimental data are available in this connection, but there are nevertheless sufficient indications that heredity is a factor of vital importance in the vine, and that the production capacity of vineyards, can be considerably increased, by more careful selection of scionwood or propagating material.

For maximum success, however, it is desirable that parent vines be labelled in the vineyards for a few successive years, since effective elimination of the poorer vines, would not be possible in a single season.

Elimination of Uneconomic Vines.

Re-grafting of strongly-developed vines. Individual vines which give unsatisfactory yields but possess normal vitality, may with advantage be re-grafted by experienced grafters, with scions from selected mother vines.

FIG. 3.—An excellent example of an economic Hanepoot vine. Note the fine fully-developed bunches.

FIG. 4.—Re-grafted vines. The three vines in the foreground were photographed 9 weeks after 20-year-old rootstocks have been re-grafted with Alphonse Lavalleé. With the large and extensive root system the grafts develop sufficiently within two years to produce virtually a normal crop.

With the exception of a certain percentage of grafts which fail to take, and the isolated vines which may succumb, it means in effect, that only about one poor crop per vine is sacrificed since, with the large and extensive root system the grafts develop sufficiently within two years,

to produce virtually a normal crop, but with this significant difference and advantage however, that the vine can occupy its place in the vineyard as a valuable economic unit.

Poorly-developed Vines and gaps between Vines. In established vineyards, with large numbers of poorly-developed vines to be removed or gaps to be filled, the matter is, however, not so simple.

Any wine farmer knows from practical experience, that it is usually sheer waste of time and energy to plant young vines in between old ones, since the former often die, or are stunted as a result of the overwhelmingly strong competition from the already established vines.

Consequently the question arises, what steps could be taken to replace such poor vines or to fill effectively, gaps in existing vineyards. For this purpose two practices could be followed.

FIG. 5.—A gap in the vine row.

(1) *Layering.*—Here the method applied is as follows: Water shoots, as low down as possible on the stem, are left to develop to a sufficient length to permit of the canes being laid in a trench of approximately 9 inch to 12 inch deep, as far as about the middle of the gap between two vines. Here the cane is bent vertically in such a way that two buds protrude above the soil surface, and is then covered with soil.

Large and strong vines will develop, since they are fed by the parent vine and are therefore not exposed to overwhelming competition. When fully developed, the vine may be cut away from the parent vine.

The disadvantages attached to this practice, is that it is not always possible to find the desirable water shoot, and that the vine develops on vinefera roots. Moreover, selection cannot be applied.

(2) *By setting of fully-developed vines in the vineyard.*—Often, when old vineyards are renewed, a certain percentage of strong and fertile vines are found, which may very advantageously be employed for this purpose.

As an alternative, it is recommended that vineyards be improved on the one side by replacing the poor or unprofitable vines by selected vines from the opposite side of the vineyard, which should then be renewed with vines from selected parent vines.

The transplanting of fully-developed vines is undertaken during the winter months when they are dormant. Care should be taken when removing vines from the soil, to damage the roots as little as possible.

The vines should be carefully inspected for firmness of the graft join, general vigour, health, etc., after which only strong, healthy vines should be selected with the least possible delay for planting in the new places in holes of about 2 ft. square and about 3 ft. deep (depending upon the length of the roots) at the original depth.

FIG. 6.—The vine on this photo was photographed 16 months after having been transplanted at the age of 15 years.

About twelve inches of soil in the bottom of the hole should be thoroughly mixed with about half a basketful of good stable manure, to which a handful each of superphosfate and agricultural lime have been added. It is most important that the soil and manure be thoroughly mixed in order to prevent damage to the young roots by burning.

During planting, the soil around the vines should be well trampled down and then thoroughly watered to enable it to settle firmly.

Short pruning is applied and any bunches appearing during the first season after planting, should be removed from the vines at an early date. The following year a small crop may be allowed in relation to the vigour of the vine.

For the development of the necessary vigour, a nitrogenous fertilizer of ammonium sulphate or ammonium nitrate may be applied at the beginning of October at the rate of about $\frac{1}{2}$ or $\frac{1}{3}$ lb. per vine, respectively, and with a thorough irrigation, if necessary.

A few thorough irrigations during summer are also most important.

Although in the past, transplanting of fully-developed vines has been carried out succesfully, this step should, in the very nature of things, be regarded as an emergency measure only.

It must, however, be pointed out that, nothwithstanding conscientious and careful selective propagation, there will always be some vines which, owing to poor vigour, poor bearing capacity or poor fertilization of the bunches, will function as uneconomic units in the vineyard. This means that, no matter how carefully a vineyard has been laid out and established, it cannot be left to its own devices. Careful observation is essential, and strenuous efforts should be made to eliminate unprofitable vines and fill the unnecessary gaps which mar the appearance of so many of our vineyards.

The Control of Geeldikkop" in Small Stock:—

[Continued from page 679

(4) If you cannot maintain your veld in such condition as to offer little more than only the poisonous duwweltjies, then you should make timely provision for additional feeding, such as lucerne and maize, to see your animals through this difficult period.

(5) Provide for shelter in all your paddocks through the planting of trees as far as possible. As soon as fresh cases of geeldikkop are noticed they should at once be removed into shade and kept there for 3 to 4 days. Remember that protection against sunlight is the first essential to save sick animals. If you cannot provide shade under any circumstances, you could blacken the ears, face and lips with any dark colouring matter which is not irritant to the skin. By this method the harmful sunlight can also be prevented from penetrating the skin in the same way as in the Black-head Persian sheep. This treatment is especially recommended in young animals during severe outbreaks of geeldikkop.

(6) As soon as the first cases are noted amongst a flock of sheep, move them on to different veld, even if only into a neighbouring camp. It is especially advisable to keep your sheep on rocky ridge veld when outbreaks are first noted. Later in the season, when there is sufficient other grazing and the duwweltjies well grown out, the stock can again be moved back into the lower parts.

(7) Sick animals standing in the shade should be provided with soft green feed, such as lucerne, and sufficient water to ensure action of the bowels. Where constipation is noted, sick animals should be dosed carefully with epsom salts and common salt (2 ounces of each) dissolved in water.

(8) It must be realized that geeldikkop is purely a grazing problem, and that it can be increased according to the extent to which veld has been damaged and trampled out. In consequence of this, annual "opslag" vegetation, such as Tribulus, penetrates into and so dominates the veld that the attention of the stock is completely drawn to this type of grazing. Moreover, it must be remembered that there are no preventative or curative remedies available by which animals can be either protected or cured when they are repeatedly returned on to poisonous duwweltjie veld.

Sheep on the Dairy Farm.

THE sheep has had to make way for the dairy cow in many closely settled countries, and has been eliminated from regions where suitable soil and other factors made the development of intensive arable farming possible.

There are many and various reasons why this development came about. Nevertheless, time has shown that for economic reasons many dairy farmers and agriculturists have been forced to bring the sheep back into their farming system.

It is a fact of general observation that sheep exerts a very favourable influence on the fertility of the soil on which they graze, whether it be sown to crops, established or natural pasture. The reason for this is that the sheep distributes its droppings as evenly as the best manure spreader, and of course much more economically. In fact, sheep go one better than the manure spreader because while travelling, as they do when grazing, they succeed, by means of their sharp hoofs, in breaking up and tramping the manure into the soil. Manure is at its best when it is applied to the soil in its fresh state. The readily available condition—detached particles—in which sheep droppings fall and spread, adds greatly to the value because the small particles come into more ready contact with the soil. Cattle dung, on the other hand, falls in great masses which foul and destroy vegetation beneath them and overfertilize the ground for a small area around. Much of the bulk does not come into contact with the soil and during rain storms a valuable mass of fertilizer is washed away. In the case of sheep manure there is much less direct loss by washing and wastage by leaching.

The analysis of the fertilizer obtained from different classes of farm animals varies of course with the food fed, but in general it can be said that sheep manure is worth roughly twice as much as that of the dairy cow.

Another important point is that sheep instinctively seek the higher ground when they are at rest. The proportion of droppings left on the high ground where it is most needed is, therefore, relatively greater than that which is left on the lower ground. The manurial run-off after a sharp shower is much less in such circumstances. But quite apart from its uses as a manufacturer and distributor of good inexpensive fertilizer, sheep can be used to great advantage as a scavanger on the dairy farm. Because it is a close feeder it makes economic use of much which the dairy cow must of necessity waste. Following the cow it will level up the pastures and utilize crop wastage. The sheep feeds right up to and around cattle droppings, and at the same time tramples and disperses the cattle dung. The sheep also makes good economic use of a great variety of weeds which the cow will not touch. Small numbers of sheep can be maintained on the dairy farm with little or no extra trouble and cost. Such maintenance costs as may be debited to the sheep will be more than offset by their contribution towards the farm's meat requirements. Mutton makes a very welcome change from trek-ox beef.

The carcase is small and on the average farm, therefore, mutton can be made available throughout the hottest summer months. It will undoubtedly reduce the cost of living and supply a welcome dietary change in the home and for the labourers. If you cannot be bothered to breed sheep, buy them and use them for economic reasons.

(P. D. Rose, Senior Professional Officer, College of Agriculture, Cedara.)

Information on Departmental Publications.

Farming in South Africa, the monthly journal of the Department, contains popular articles as well as notes on scientific subjects dealing with a variety of agricultural topics, useful to both the farmer and the housewife.

The following particulars in regard to subscriptions and advertisements should be noted:—

Subscription.—Within the Union, South West Africa, Bechuanaland Protectorate, Southern Rhodesia, Swaziland, Basutoland, Mocambique, Angola, Belgian Congo, and British Territories in Africa, 5s. (otherwise 7s. 6d.) per annum, post free, payable in advance.

Applications, with subscriptions, to be sent to the Government Printer, Bosman Street, Pretoria.

Advertisements.—The Tariff for Classified Advertisements is: 2d. (two pence) a word with a minimum of 5s. per advertisement (prepaid). Repeats, not entailing any change in the wording, will be published at half the cost of the original.

Conditions:

(1) The advertisement will be classified under specific headings, and only one black letter (initial letter) is permitted.

(2) Advertisements in which prices are mentioned must contain the name and address of the advertiser. A nom-de-plume or box number only is not sufficient, and unless this condition is strictly observed, advertisements will not be accepted.

(3) Advertisements will be classified strictly in accordance with the subject-matter of the announcement, determined by the first item mentioned and cannot be inserted under irrelevant headings.

(4) Displayed, classified advertisements will also be accepted. The charge, however, will be 10s. per inch, single column, per insertion, without reduction for repeats.

Copy for Advertisements to be in the hands of the Government Printer, Pretoria, not later than the 20th of the month preceding publication.

Send all advertisements direct to the Government Printer, or write to him for details as to tariff for advertisements.

"The Woman and Her Home", the first official monthly journal for women will be published during January 1949. The subscription is 5s. per annum, and should be forwarded, together with the address, to the Government Printer, Pretoria.

Crops and Markets.—A monthly bulletin, issued by the Division of Economics and Markets, containing information on crop prospects, market prices and export of agricultural produce.

Popular Bulletins.—Bulletins on various agricultural topics are published by the Department to meet public demand. A list of available bulletins giving particulars of cost, etc., is obtainable free of charge from the Editor, Department of Agriculture, Pretoria.

Scientific Publications.—From time to time the different Divisions of the Department issue science bulletins incorporating the results of research work conducted by them. Other scientific publications issued are: "The Onderstepoort Journal", "Memoirs of the Botanical Survey of South Africa", "Bothalia", "Entomological Memoirs", "Flowering Plants of Africa", and the "Annual Reports of the Low Temperature Research Institute". Information in regard to these publications is obtainable from the Editor, Department of Agriculture, Pretoria.

Press Service.—A bulletin giving information on agricultural subjects is supplied specially to the Press of South Africa. This information, which at present is supplied fortnightly, is then disseminated by all newspapers and journals throughout the country.

Farmer's Radio Service.—In addition to the printed information supplied by the Department to members of the farming community, the Department, in collaboration with the South African Broadcasting Corporation, also has a national broadcasting service for farmers. Information in regard to times of broadcasting is contained in the programmes issued by the Broadcasting Corporation.

Inquiries.—All general inquiries in regard to the above should be addressed to the Editor, Department of Agriculture, Pretoria.

D. J. SEYMORE, Editor.

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[*Photo on Cover*: Merino Rams at Grootfontein Agricultural College Middelburg, Cape.]

G.P.-S.7882—1948-9—8,250.

FARMING IN SOUTH AFRICA

VOL. 23 NOVEMBER 1948 No. 272

Editorial:

Our Grazing, A National Asset.

THE soil, with its natural covering, is undoubtedly man's greatest asset. In South Africa, more than in any other country, this natural covering is of primary importance. Yet it is the most neglected aspect of our farming.

The value of the natural veld can only be thouroughly appreciated when one considers that approximately two-thirds of the Union has an annual precipitation of only 25 inches, or less, and that, at the moment, only 6 per cent. of the Union's soil is under cultivation and that this percentage it not likely to increase to more than 15 per cent. No wonder, then, that South Africa is regarded mainly as a stock breeding country. Furthermore, a precipitation of 25 inches is regarded as the minimum required for the economic production of cash crops. Fodder crops can, however, be successfully cultivated under lower rainfall conditions.

Hence South Africa is to a very large extent dependent on her natural veld and this important asset is worthy of much more attention than it has received in the past. The fact that the veld has deteriorated brooks no denial. The encroachment of Karoo conditions on the former grassveld areas, the extensive appearance of punitive plants, e.g. Renosterbos, "harpuis" (*Euryops multifidus*), steekgras, vermeerbos (*Geigeria passerinoides*), bitter karoo (*Chrysocoma tenuifolios*) to mention but a few, are signs of deteriorated and damaged veld. It is estimated that approximately 9 million morgen of the Union's best grazing in the bushveld-areas are already too densely afforested, or menaced by serious bush encroachment. This is mainly due to injudicious veld management in the past. Furthermore deleterious veld practices have reduced its production level as well as its quality. The stranglehold of erosion menacing our country to-day, is largely the outcome of veld deterioration and pernicious veld practices.

Fortunately our farmers are fully alive to-day to the deterioration of the veld and its concomitant dangers. In other words, our farmers are veld-conscious, and they are very anxious to restore this cheap source of animal feed to its highest production level. The policy of supplying information in regard to judicious veld management, commenced by the Department of Agriculture some 20 years ago, is now bearing fruit. *Veld management envisages judicious veld management with the object of raising production to its maximum level without injuring the veld.* This is no easy task, requiring, *inter alia,* a thorough knowledge of the requirements of the diverse vegetation found on the veld.

The farmer must have full control of the veld and this is possible only with judicious and adequate paddocking, which of course, calls for considerable fencing material—a commodity at present in short supply. A further requirement is a watering-place in each camp; for this, water drills, windmills and reservoirs are necessary. We look forward to the

time when these necessities will once more be available at reasonable prices.

The Department commands sufficient knowledge to-day to be in a position to place veld control in the various ecological regions of the country on a sound basis. Veld control experiments conducted by the research division in the past 15 years, have thrown considerable light on this intricate farming practice, and to-day, the farmer can apply various systems of veld management, according to the conditions on his farm.

With farm planning under the Soil Conservation Act, the utilisation of the natural veld will come into its own. To simplify the extension officer's task of transmitting this knowledge to the farmer, the Division of Soil Conservation and Extension is having the various systems of veld management and relevant explanations printed in leaflet form, for distribution amongst the farmers. These systems will serve mainly as a guide to indicate the correct direction and can be modified to suit local conditions, provided that the underlying principle is followed.

The question is often posed, whether systematic veld management embracing paddocking, water provision, etc., would be profitable. That this is so has been proved by many farmers who for years have been applying sound veld management. They have demonstrated too, not only that the carrying capacity of such veld considerably increased but also that a product of a higher quality is obtained.

The future of our agricultural industry will not be bright before the natural veld receives due appreciation and is treated as a valuable and irreplaceable gift of nature.

(J. J. Morris, Senior Professional Officer, Division of Soil Conservation and Extension.)

Arsenic for Sale.

The Chief Locust Officer, No. 5, Albert Road, Pretoria, has the following supplies of arsenic available for sale f.o.r. Pretoria-West Station:

(*a*) *Arsenic fluid* (*mixed with molasses*).

18 three-gallon drums.
134 four-gallon drums.
2 five-gallon drums.
85 forty-gallon drums.
11 forty-four-gallon drums.
} Price 1s. 9d. per gallon.

(*b*) *Arsenic fluid* (*without molasses*).

22 forty-gallon drums. Price 1s. 9d. per gallon.

N.B.—The arsenic will be available to farmers' organizations only and not to individual farmers. Orders must be placed for quantities in drums only and not for small quantities in gallons or pounds.

Nursery Quarantines.

The following nursery is the only one in quarantine as at 1 November, 1948:—

Montrose Nurseries (Pty.), Ltd., Lochaber, P.O. White River, on citrus (part) for red scale.

Wool, the Wonder Fibre.

The History of Wool and the Textile Industry.

J. C. de Klerk, Sheep and Wool Officer, College of Agriculture, Glen.

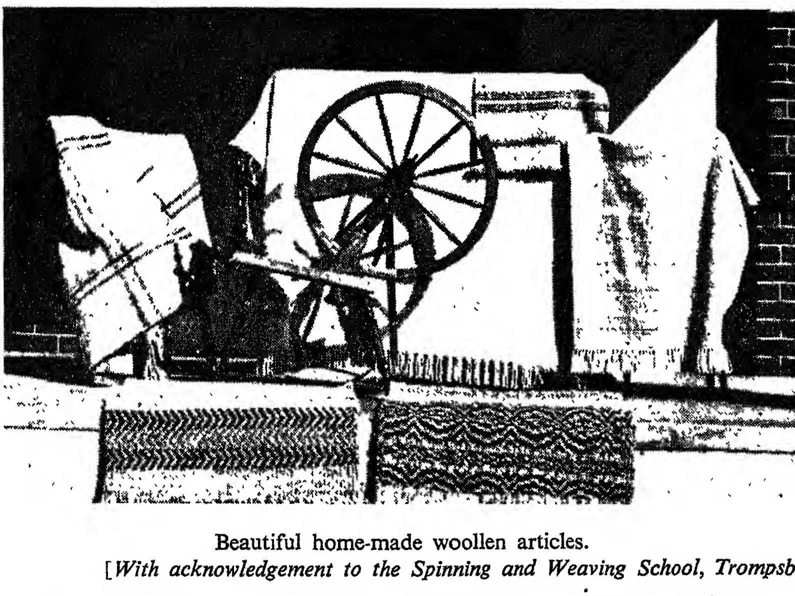
(1) Historical Background.

WOOL, natures golden fleece, is one of the oldest fibres used by man in the manufacture of textiles, dating as far back as the ancient Egyptian civilization 3,400 to 30 B.C. During the Babylonian and Assyrian periods wool was the most important fibre, and during the later Roman period, it took its place next to cotton and linen (flax).

The weaving of textiles was already known in the year 4,000 B.C., and dyes were obtained from certain minerals and plants.

Origin of the Merino Woolled Sheep.

The woolled sheep (*Ovis aries hispanica*) originated from Asia Minor. The Phoenicians were the first to breed for wool improvement along systematic lines. Centuries before Christ they carried on an extensive trade with Mediterranean countries, and wool played an important part in their merchandise.



Beautiful home-made woollen articles.
[*With acknowledgement to the Spinning and Weaving School, Trompsburg.*

The Phoenicians established settlements at various places, and introduced the woolled sheep into several of these. One such settlement was Cadiz in Spain. From Asia Minor the woolled sheep was introduced into Greece, most likely by the Phoenicians. Here, on account of the favourable climate, it thrived well and the Greeks applied themselves to careful breeding. In order to produce good wool they even protected the sheep with skins or something similar.

Greek civilization spread to many parts of the Mediterranean, and the woolled sheep was introduced into one of the Greek colonies, namely Massilia (Marseilles) at the mouth of the river Rhone from where it spread across Southern France and Spain. The Greeks also introduced the woolled sheep into Southern Italy, and so it found its way into the

later mighty Roman Empire, which played no small part in its improvement. So important was the woolled sheep that it even served as a medium of exchange.

Spain is one of the many territories conquered by the Romans, who presumably promoted the transportation of woolled sheep to Spain, perhaps not direct from Italy, but from Northern Africa. The breeding of woolled sheep reached a remarkably high standard of development among the Greeks, Romans and Phoenicians.

Fortunately, the woolled sheep did not disappear entirely with the decline of the Roman Empire, since it had already found its way to the Iberian Peninsula where it thrived well, and, secure form disturbances made good progress.

The Spanish woolled sheep, in contrast with its progenitor of Asia Minor, was a hardy breed owing to the fact that the sheep was in the open throughout the year and frequently had to trek over long distances.

In Spain the natural conditions were particularly favourable to the woolled sheep, especially on the Castilian plateau where the rainfall was signally low. The dry climate militated against the permanence of the grazing, so that already at an early period the migratory habits developed in Spain. In early summer they trekked with the sheep from the warm plains of Southern Spain, Estremadura, Andalusia and New Castilia, to the cooler mountainous regions of the North, Old Castilia and Burgos. Early in winter, the return trek started, and so a hardy breed was developed.

It was here that the name "Merino" (Spanish for "Judge") originated. The "Merinos" were appointed and invested with authority by the Government to settle differences among shepherds. To-day the word "Merino" means in Spanish "a shepherd".

The Spaniards greatly improved the Merino and exercised a monopoly; infringements were punishable even by death. This monopoly resulted in overproduction and laxity was manifested in the strict observance of the prohibitions. The Spanish Crown presented other European rulers with some of the best sheep. Later, in 1723, Philip V granted Alstromer, a Sweed, permission to export some sheep to Sweden.

In 1873 Louis XVI bought a farm, named Rambouillet, 40 miles from Paris, and selected Spanish sheep were sent there. Through selection and breeding the most famous sheep farm in the world was established there. From France numbers of these sheep found their way to many parts of the globe, including South Africa. In 1789 the Merino was introduced to Holland, England and South Africa, and since 1800 also into America and Australia. Here the special Merino types, the Vermont and Wanganella, were developed. During the Napoleonic Wars in Spain, the Merino breed there went to rack and ruin.

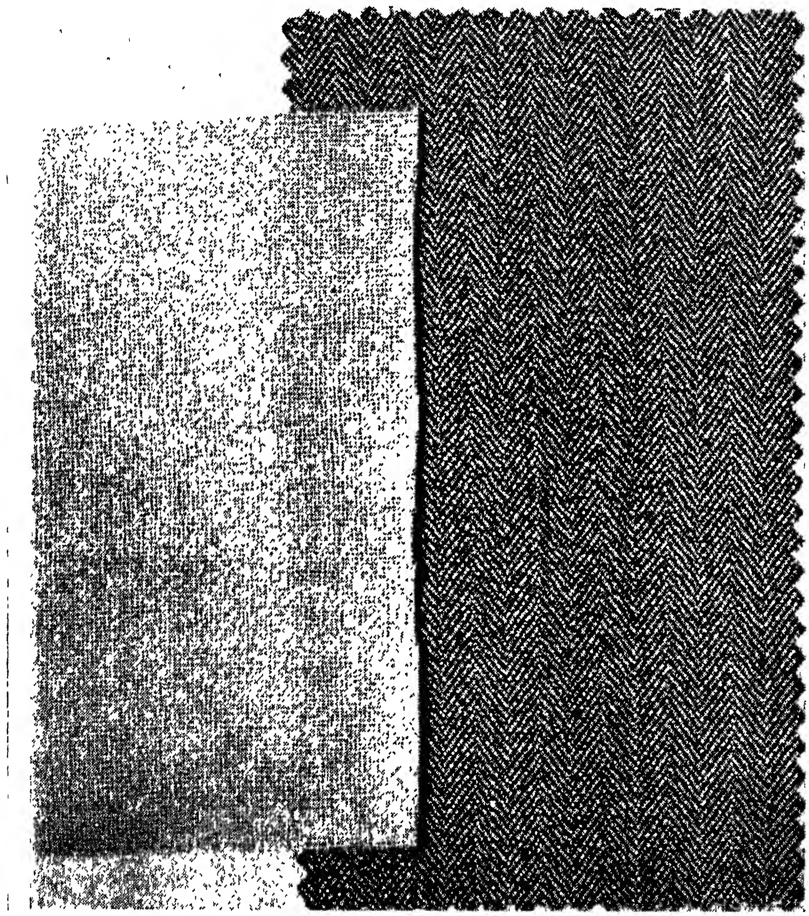
Early in 1789 Col. Gordon, Officer Commanding the Cape Militia, imported 4 ewes and 2 rams from Holland, not for a hobby but for establishing an economic industry and for the maintenance and advancement of the people. The sheep were placed on the Government farm, Groenkloof. A few years later Holland requested the return of these sheep, but only to the same number as were originally sent. Gordon retained the sheep bred here.

Shortly after the first British Occupation of the Cape, Gordon committed suicide and his effects, among which was the little Merino flock, were sold in 1797. By a coincidence there happened to be two ships in Table bay, the "Reliance" and the "Supply". Waterhouse, the Captain of the "Reliance", was a great friend of John Mac Arthur,

the ardent and indefatigable protagonist of Merino sheep breeding in Australia. Captain Waterhouse, who knew of Gordon's sheep, and Kent, Captain of the "Supply", jointly purchased the rams and ewes for New South Wales at £13 a piece. In this way South Africa lost some of her first woolled sheep. Gordon's imported sheep were from the original imports of Spanish Merinos into Holland.

Development of the Wool Industry in South Africa.

Three years after the arrival of Gordon's sheep the Van Reenen brothers obtained 3 rams from him, and put them to 300 selected Cape ewes. They then set themselves the task of systematic and purposeful breeding and improvement. On the dissolution of partnership in 1795,



From Left to Right:

(a) "Woollen". (b) "Worsted".

Jan Gysbert and Sebastian Valentyn each acquired 150 half-bred Spanish ewes and 2 pure-bred Spanish rams. Before Gordon's death, Sebastian Valentyn also acquired 2 pure-bred ewes from him. Thus, he was the first South African to acquire pure-bred rams as well as ewes of the Spanish Merino. This was the foundation of the Merino industry in South Africa.

Economic Importance of the Sheep Industry to the Union.

The following brief summary will serve to indicate the importance of the sheep and wool industry in the Union.

Export value of wool (in 1927): £17,067,984.

Export value of skins (in 1929): £1,801,135.

Export value of wool (in 1947/48): £22,352,561.

The number of sheep slaughtered during 1946 in controlled and uncontrolled areas was 3,400,000 and calculated at an average carcase value of 24s. each and exclusive of the value of offal and skins, it meant an income to sheep farmers of over £4,080,000. Then there is also the value of sheep as a means of payment in kind to farm labourers and as meat for household consumption. The sheep and wool industry is in fact a greater asset to the Union of South Africa than its gold.

(2) Development of the Spinning and Weaving Industry in Europe.

Originally the equipment of the spinning and weaving industry was, naturally, very primitive. The grease wool was washed in tubs and then carded and combed by hand, by which means the fibres were arranged in a more or less straight and parallel relationship suitable for spinning into yarn. In those days the hand spinning wheel was in common use and usually this work was performed by the women and daughters in the family. Originally the loom also had to be worked by hand—a tiresome and monotonous operation.

The first improvement in the weaving process was heralded in 1750 with the invention by the English inventor, Kay, of the automatic flying shuttle. Up till then the shuttle was passed to and fro by two persons, usually men. Kay's shuttle returned automatically, so that one person was now able to do the work hitherto performed by two.

The next important invention was the spinning jenny of James Hargreaves. At that time one person could spin only one thread at a time but this invention enabled one person to spin eight threads simultaneously. After further improvements it was possible to spin 80 threads simultaneously, so rendering obsolete the common spinning wheels for all time.

The next invention to revolutionise the textile industry was Richard Arkwright who invented a machine which performed the entire process.

Crompton* virtually perfected the process of mechanisation by designing a machine which incorporated the best features of both Hargreaves and Arkwright machines, this machine he called a "mule" because it was a hybrid derived from two other machines. The mule could produce the finest, attractive and most durable yarn.

These inventions, together with others, as for e.g. the invention of the first carding machine by Lewis Paul, ushered in the Industrial Revolution and with James Watt's invention of the steam engine in 1782, the wool and textile industry assumed gigantic proportions vitally affecting every human being to-day in some form or other.

(3) Wool Processing.

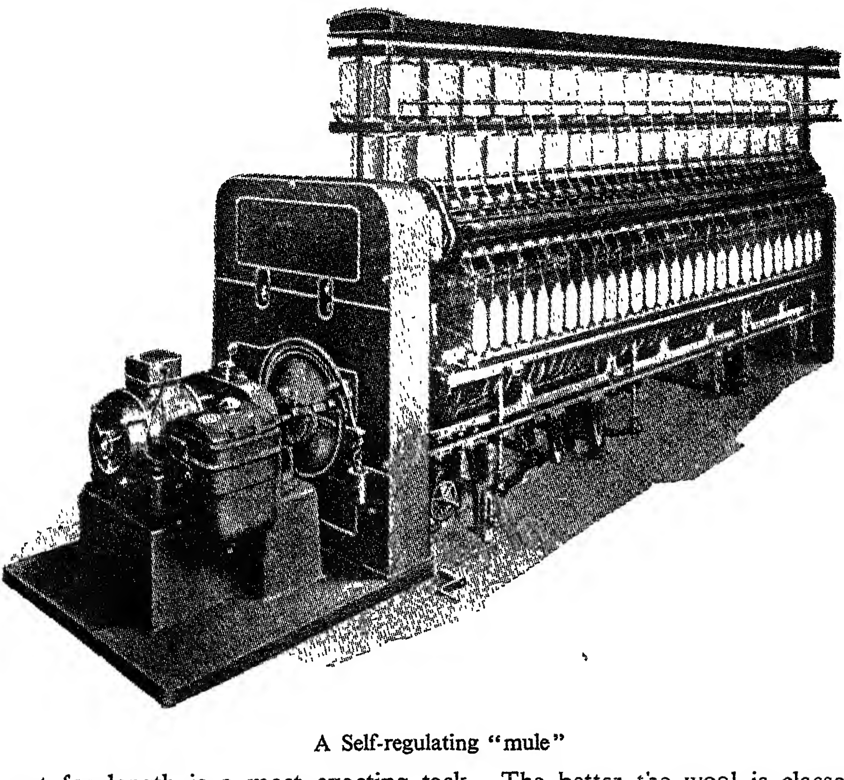
In taking a broad survey of the wool textile industry, one is struck by its extreme subdivisions. Few factories overseas manufacture wool from the raw state to the finished article. Each branch of the industry plays a small part only in the long manufacturing process. Firstly, there

* Originally these improvements were all effected in the Spinning and Weaving of cotton; in course of time they were also introduced into the wool industry.

are the wool merchants who buy the wool and sell it to manufacturers, combers and topmakers. Secondly, we have the topmakers who buy, sort and blend the wool and prepare or card it suitable for topmaking. Thirdly, there are the combers who work on a commission basis and comb the wool for those topmakers who have no combing machines. Fourthly, there are the spinners who buy the tops and make them into yarn. Fifthly, the weavers who buy the yarn from the spinners and weave the fabric. Sixthly, the dyers and finishers who scour and dye the finished cloth, usually on a commission basis. Finally, there are the distributors or wholesalers.

Sorting.

The first step in the manufacturing process is the sorting of the wool. This is done by experienced well-trained men who sort the wool according to length and quality. This work is done on a piece-work basis. It is not difficult to sort the wool for different qualities, but to



A Self-regulating "mule"

sort for length is a most exacting task. The better the wool is classed therefore in the shearing shed, the larger the quantity that can be sorted within a given period. Consequently sorters can be paid at a much lower rate when the wool has been well classed and proportionally much more for badly classed wools.

Blending.

After the wool has been sorted, it is blended. Wools from different sources are blended in order to obtain material with certain properties, or to obtain a desired effect. The price factor is also extremely important. Thus, in various factories we may find pure Australian or Cape wool, or a mixture of the two in varying proportions. South American and

Canadian wools of the same quality are also frequently incorporated in these blends in definite proportions.

Scouring.

After the wool has been blended it is scoured but if seedy it must first be carbonised. This is done by treating the scoured wool with diluted sulphuric acid. Superfluous moisture is than expelled by press-rollers, followed by heating in a baking oven which causes the burrs and seed in the wool to carbonise. By the aid of crush-rollers and shaking, the carbonised seed is readily removed. The wool is then neutralised to remove all traces of acid, and again scoured for a second time. The carbonising of wool is a very expensive process and such carbonised wool is suitable only for the woollen industry since the wool is damaged to such an extent by the heating process as to render it unsuitable for the worsted industry.

The most popular cleansing method is the alkaline emulsion scouring system. This machine consists of a series of steeping bowls containing hot water, soap and alkali. Excessive or insufficient scouring adversely affects the subsequent processing. Ram's wool and other heavy conditioned wools must always be more thoroughly scoured to remove the additional greasiness. The scouring costs range from 1d. and more per lb., depending on the amount of grease, sand, dirt, etc. present in the wool.

There are also other scouring systems such as the desuinting, the solvent and Du Hamel systems. In the last-mentioned system the natural grease of the wool is used as a detergent.

After the wool has been scoured it is dried in a drying machine supplied with a continuous blast of hot air.

By-products.

The wool-washeries furnish valuable by-products which may be reclaimed. One of these is wool grease which, after it has been refined, is known as lanolin and is used as a basis in the manufacture of soap, candles, oil, lubricating oil, printer's ink, shoe polish, varnish, in rope-making and the steel industries.

Another important by-product is potash salt which is the most important constituent of the suint and may be converted into ordinary potash fertilizer.

The Woollen and Worsted Industries.

Up to the scouring stage all the wool is similarly treated, but after that there is an important differentiation as follows: All the short wools find their way into the woollen industry and all the long wools into the worsted industry- the dividing line being approximately 2 inches. There is a further subdivision in the worsted industry; all the wools above 8 inches long are "prepared" and those below 8 inches "carded". This differentiation is extremely important, since the two systems vary greatly as regards processing costs, raw material used, yarn structure and the finished article. The following are the most important differences:—

The woollen industry has a vast source of raw materials to draw upon since it can employ short wool of the very best quality down to Persian and Indian wool of the poorest quality. Ad-mixtures of cotton, silk, woollen noil and wastes, tender wool and wool reclaimed from rags (shoddy) etc. can also be used. From these, materials ranging from the finest quality in the world to the poorest and coarsest are manufactured. This is in direct contra-distinction to the worsted industry, since the

woollen industry requires short fibres and can utilize anything with two ends. The woollen yarn has no definite structure—it is simply an intermingling of fibres with no parallel relationship between the constituent fibres. The finished fabric has a bulky and woollen appearance and the weave structure is obscure.

Another important difference between the woollen and worsted industries is to be found in the fact that in the woollen industry the wool is not combed and the raw material passes through only about 5 to 8 processes before it is ready to be woven into a fabric.

The worsted trade on the other hand uses only sound pure virgin wool of good length. Before the worsted yarn is spun it passes through at least 18 to 25 processes, all designed to produce a smooth, uniform yarn. The finished cloth has a smooth surface and the weave structure is clearly distinguishable. This is made possible by the fact that only long fibres are used, the short fibres or noil being removed by combing. The fibres in the yarn itself all have a parallel relationship. The processing into yarn and cloth subsequent to scouring, is briefly as follows:—

Carding.

After the wool has been scoured and dried, it is carded. The method of carding wool in the woollen industry differs in more than one respect from that in the worsted trade, but the fundamental principle is the same for both, viz. that the entangled mass of fibres is opened up, laying them in a roughly parallel formation and ejecting them in a continuous and regular sliver formation. On the last machine in the carding process, the sliver is separated into a number of threads or rovings which are wound on to bobbins ready for spinning on the "mule" and subsequent weaving.

Carding is a very delicate process and too much attention can never be given to every aspect of this process.

Preparing.

The worsted carding machine is not adapted to all kinds of wool, since wool with a long staple is very liable to get broken in it. Such wool is "prepared", commonly called the English or Bradford system. By "preparing" is meant that the wool is passed through a series of gill boxes in which revolving combs or fallers separate and straighten the fibres so that they will be in a form suitable for combing.

Backwashing.

Attached to the worsted carding machine is a washing appliance which removes all impurities remaining after the first scouring process or becoming detached as a result of the carding process. At this stage oil (usually olive oil or an emulsion thereof) may be added for oil combed tops and if necessary, "blueing" can also be done.

Combing.

The carded or prepared sliver is then finally ready for combing. This is an essential process since here the fibres are finally straightened out and the short fibres separated from the long ones. Different types of combs are used depending upon the wool to be treated.

"Top" and "Noil".

The short fibres which are combed out are called "noil" and the long fibres the "top". The value of wool is largely determined by the proportion of top to noil, known as the "tear" and the wool-buyer

must estimate this tear when examining the grease wool. By estimating the tear as well as the clean yield of the raw wool, he can estimate the price he is prepared to pay. The combing charges depend upon the tear; thus, the cost of combing a good shafty merino wool with a tear of say, 5:1 is about 3¾d. per lb., whereas the combing cost of wool with a tear of 3:1, is about 5½d. per lb. (pre-war prices). In order to have a good tear (and to command a good price from the producer's point of view) the wool must be sound, since all tender and weak fibres will be removed by the combs and noil. Furthermore it is extremely important that the length should be as uniform as possible since the combs may be adjusted for combing different lengths of wool but cannot simultaneously treat wool of varying lengths. After further processing we have the finished top which is now ready for "drawing".

Drawing.

The term "drawing" in the worsted industry denotes the various successive processes employed to convert the top into a thin roving suitable for being spun into yarn on the spinning frame. The number of these processes varies from 7 to 10.

Different drawing systems are applied according to the type and quality of the wool. For long wool, cross-bred wool, shafty merino wool, mohair, etc., the English or "open" system is used. Secondly we have "cone" drawing which is used for the manufacture of high quality fabrics and knitting wool from fine merino wool and fine cross-bred wools. These machines, are however, very intricate and expensive requiring trained craftsmen to handle them. Twist plays an important rôle in the English "cone" drawing systems and distinguishes them from the French or "porcupine" system in which no twist is used.

Without twist the fibres are free in arrangement, soft to handle and lofty in appearance.

The latter system which is very popular in Europe for working merino wool, is undoubtedly the system which will be adopted should South Africa establish its own worsted mills.

Spinning.

When finally, a roving has been produced of the desired thickness and weight, it is spun into yarn according to the required spinning count. There are no fewer than four different kinds of spinning frames, all being alike in respect of drafting the roving into yarn form, but differ in the method in which the twist is inserted in the yarn and in winding it on the bobbins.

Weaving.

The finished yarn is used in the weaving process. This is done by interlacing the different threads at right angles to one another and according to a given design. The threads which lie lengthwise in the loom are called the warp and it must be absolutely sound, since these threads remain taut throughout the weaving process. Unless all the fibres are strong, breakages will occur with the result that the warp will not open properly in shedding; moreover they may be broken or passed over, instead of under, by the weft thread, causing an imperfect cloth.

Burling and Mending.

When the fabric leaves the loom it is still in an imperfect condition, owing to various causes. An expert detects all the faults and the fabric is then passed on to the next process of burling and mending. The burler

[*Continued on page* 735.

Nile Grass (*Acroceras macrum*).

J. P. Botha, Officer in Charge, Athole Pasture Research Station, Ermelo District.

THE grass species *Acroceras macrum*, or Nile grass as most farmers call it, is an indigenous grass from Moorddrift in the Northern Transvaal. This same grass or closely related sub-species are also found in various parts of Africa, within and outside the Union. The grass is found in places as far apart as Berea (Natal) and Eldoret (Kenya). It is also found near Broken Hill (Rhodesia) and Mossamedes and in the marshes of the Kunene River (Angola). In Northern Rhodesia the grass sometimes called "swamp rye grass". Other *Acroceras* varieties are known in India and in tropical America, while *Acroceras oryzoides*,, which is not unknown in the Union, originally comes from Jamaica.

Description.

Acroceras is a summer grass and does not remain green during winter. Some varieties grow upright, while others have a prostrate or running habit. The plant spreads by means of underground shoots

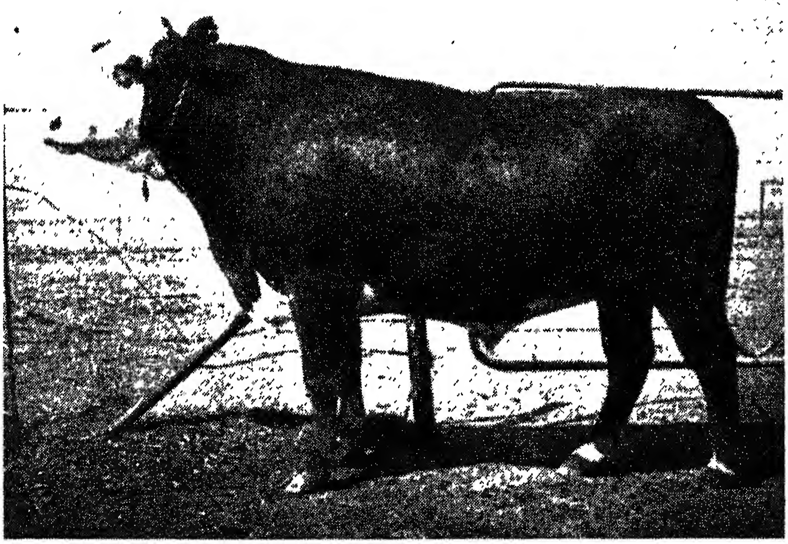


FIG. 1.—Fed on *Acroceras* hay and silage.

appearing on the surface, each time farther from the original plant, or by developing roots at the internodes of the stolons where they come into contact with the ground. Botanically, the various local forms have until now been regarded as the same grass with only the natural habitat as an indication of any possible difference.

Whatever their habit or habitat may be, the various types which have thus far been planted seem to have one important feature in common, viz., their palatability.

At the Athole Research Station near Ermelo, extensive experiments have been carried out during the past seven years with the variety

which comes from Moorddrift, and the results which are discussed here concern this variety only.

The grass was first planted on a small scale at the Rietondale Research Station near Pretoria. About 1935 a number of roots, together with other grasses, were sent to this institution and a small plot in the nursery was planted with the grass. In his report on the nursery work during the year 1935-36, Preller mentioned, amongst others, *Acroceras macrum* as one of the grasses which grew best. The grass adapted itself so well to local conditions that in January, 1938, a whole morgen could be planted, and at present the planting covers an area of seventeen morgen.

Method of Propagation.

Unfortunately, *Acroceras macrum* sets very little seed. The great majority of seed-stalks usually remain without any developed seed. That, however, does not mean that the grass never runs to seed. Seeds do appear and interesting variations of the grass have been obtained at the Prinshof Grass-breeding Station at Pretoria by planting such seed. But seed-setting is so rare that the use of seed cannot be regarded as a practical method of propagation. The only practical method of propagation is with roots.

In the first plantings at this institution, the roots were planted by hand in rows. This method demanded much labour and the cost of planting per morgen was therefore high.

A cheaper and quicker method was tested with success in 1940. After the roots had been taken out of the soil and the soil had been shaken from them, they were sliced with an ordinary cutter, so that the pieces were about 1½ inches long. These pieces were sown on prepared soil, worked in with a disc-harrow and then rolled down. The method was so successful that the first cutting of hay could be reaped within five months after the land had been sown.

Later it appeared, however, that it depended on weather conditions whether the method was successful or not. If dry, warm weather is experienced immediately after the roots have been sown, and especially if the soil is not sufficently moist, the danger exists that the roots which have not been worked in deep enough by the disc-harrow and are thus near the surface or sometimes partly lie on top of the soil, dry out and die. This causes a feeble and irregular stand.

Better results were obtained when the roots were ploughed in instead of being worked in with the disc-harrow. Here the roots may be sown on the land and then ploughed in, or they may be strewn in the furrow and then covered by the plough.

Both methods have been applied with success, although the latter is more advantageous in practice. With this method it is not necessary to slice the roots, and as the roots in the furrow are closed up almost immediately, there is no unnecessary exposure to the sun which could cause drying out.

An ordinary two-furrow plough may be used. Roots or bundles of roots are placed about eighteen inches apart in the furrow. Four natives, each with a bundle of roots in his arms, are sufficient to keep pace with one plough. It is not necessary to bend down in order to place the roots at exactly equal distances from one another. It is sufficient if they are dropped more or less eighteen inches apart in the furrow. No part of the roots need protrude above the soil. It is

advisable to harrow the soil level after the grass has been planted, to facilitate the handling of hay-making implements.

The grass does not sprout soon. Sometimes it takes weeks before the first plants appear above the surface, and after this it may take weeks before all the plants are out. Naturally the period varies considerably according to the depth at which the roots are planted. It is advisable not to plough too deeply, otherwise weaker plants may never reach the surface.

Under local conditions, the first cutting of hay may usually be obtained 5 to 5½ months after the roots have been planted.

Type of Soil.

Acroceras has successfully been cultivated on loamy and sandy loam soils, and in one case on clayey loam soil in the Eastern Transvaal.

FIG. 2.—Fattened on *Acroceras* hay.

It is impossible to predict at this stage how the plant will grow on other types of soil, although possibly the rainfall, more than the type of soil, will be the determining factor.

Rainfall.—Acroceras flourishes in areas with a comparatively high rainfall. In the Eastern Transvaal it is cultivated successfully under a rainfall of 30 to 45 inches per year. Probably the grass will not be such a success where the rainfall is much lower than 30 inches.

Time to Plant.

The best time to plant roots is in spring after the first good rains. It is advisable to plant in January or February on old weed-infested lands. At this time of the year the best growing-period for weeds has passed, and the grass has a chance of becoming established without excessive competition from weeds. If, however, it is planted as late as this, no hay can be expected before the next season.

On many weed-infested lands there are usually more weeds and sweet grass visible than *Acroceras* during the first season and sometimes even during the second season, but as a rule the grass already gets the better of the weeds during the second season.

The rate at which the grass establishes itself on such a land naturally largely depends on the planting density of the roots. The nearer the roots are placed to each other in the furrow, the sooner will the grass become established.

About 12 bags of roots per morgen are usually sufficient to ensure a good stand.

Although it spreads underground, *Acroceras* does not possess the same undesirable tendency as kikuyu, for exampl,e to overrun lands. In the case of a morgen of *Acroceras* planted in 1938, the grass hardly spread two feet beyond the original bounderies of the land, and that after a period of six years. The grass must be regarded as permanent. It cannot be easily ploughed out, and it is therefore not suitable for a system of rotational cropping.

Fertilizing.

At this institution it was customary to apply 400 lb. phosphate (super rock mixture) per morgen before the grass was planted, and after that every year another application of 400 lb. of the same mixture. It seems, however, as if better results may be obtained if the initial application is increased to 800 or even 1,200 lb. per morgen when the grass is planted and then not to apply phosphate before the soil is ploughed again.

Acroceras reacts very well to nitrogenous fertilizers such as ammonium sulphate or sodium nitrate, and when these materials are obtainable again it will be profitable to apply up to 400 lb. per morgen annually.

The grass can advantageously be fertilized with compost and kraal manure. This manure must, however, be applied to the soil before the grass is planted. In the case of established grass showing signs of deterioration, it is advisable to strew compost or kraal manure over the soil and then plough it in. This procedure ought not to be necessary more than once in four or five years.

Fertilizing costs at this institution vary from 6s. 8d. to 19s. per ton hay.

During the 1941-42 season the cost of fertilizing a piece of land of five morgen, which had received an application of 400 lb. phosphate and 400 lb. ammonium sulphate per morgen, was only 10s. 3d. per ton hay, ammonium sulphate being reckoned at £15. 17s. 6d. per ton, superphosphate at £5. 7s. 6d. and rock phosphate at £5. 10s. per ton.

During the 1942-43 season the cost on the same land with an application of 400 lb. superphosphate and 500 lb. sodium nitrate per morgen, was 19s. per ton hay, sodium nitrate being rekoned at £15. 17s 6d. and superphosphate at £4. 18s. 6d. per ton.

It may be mentioned that the soil on which these results were obtained is extremely deficient in both phosphate and nitrogen. The soil is sandy and shallow with a hard layer of ouklip near the surface.

Hay Yields.

In Progress Report No. 2 ("*Pasture Research in South Africa*"), Preller reports that the yield of *Acroceras macrum* on nursery plots is equal to 16 tons per morgen.

Nursery conditions are, however, difficult to maintain on a large scale and it must also be expected that in practice, yields will be much lower than the above figure. The highest yield on a large scale at this institution was 41·9 tons hay from 5 morgen, which is equal to 8·38 tons per morgen, and in another instance 8·5 tons hay was reaped from one morgen.

Yields during the first season are low because the grass is not yet properly established. The highest yields are usually obtained during the second season, after which there is a definite decrease. After 5 years it must be expected that the yields will decrease severely owing to a too dense growth and at this stage it is necessary to plough the land in order to ensure new growth.

The first morgen of *Acroceras* which was planted at this station, gave an average yield during the 6 years of 5 tons hay per morgen.

This figure, however, is only representative of the yield which was reaped as hay. During four out of the six years, only one cutting of hay was taken, while the production for the rest of the season was grazed

FIG. 3.—A stand of *Acroceras* grass, five months after the roots were ploughed in.

off, and even when two cuttings were reaped, the land yielded a considerable amount of after-growth for grazing. The figure of 5 tons per morgen is thus definitely lower than the actual yield.

Palatability and Value of the Hay.

Acroceras is a particularly palatable grass in both the green stage and in the form of hay.

Cattle definitely prefer *Acroceras* hay to the hay of most other grasses, whether natural or planted.

Feed experiments with *Acroceras* hay were carried out at this institution during three successive winters.

The animals used in the experiment were mainly Hereford cross or Hereford grade oxen. At the beginning of the experiment the animals were in good condition.

The oxen were fed in kraals provided with shelters and were allowed to eat as much of the hay as they wanted.

Bone meal and salt were provided in sufficient quantities during the experiment.

The duration of the various experiments, as well as the individual and average increase, are shown in the table.

Results of Feed Experiments with Acroceras *Hay.*

Year.	Date.		No. of days.	Gains of experiment animals.			Average Increase.	Average increase per day.
	From.	To.		1	2	3		
1941	8 May	25 Sept.	140	24	–20	48	17 lb.	0·12 lb.
1942	7 May	3 Sept.	119	220	148	250	206 lb.	1·73 lb.
1943	15 May	11 Sept.	119	215	190	180	195 lb.	1·63 lb.

It is remarkable that the average increase was exceptionally small in the first experiment, and also much lower than that in the subsequent two winters.

In 1941, however, the hay was cut too late. The grass had already passed the hay stage and it was overripe. The result clearly proved the necessity of cutting hay at the right stage.

In 1942 and 1943 use was made of prime hay. The grass was cut at the right stage, i.e. just when it was in full seed. The hay was of a dark green colour and had a good flavour.

Average increases of 206 and 195 lb. respectively in a period of 119 days must be considered very satisfactory, especially if compared with Morrison's figures for lucerne hay.

According to Morrison, lucerne hay indicated increases averaging only 1·20 lb. per day over periods of 110 days in fattening experiments, and when a limited quantity of cereals was also fed, the daily increases were 1·65 lb., i.e. ·45 lb. higher.

Even with cereals as supplementary feed, the daily increase with lucerne hay was thus about the same as for *Acroceras* hay alone during 1942 and 1943.

These figures undeniably prove the high feeding value of *Acroceras* hay.

Taking into consideration that this grass grows well in the Sourveld areas of the Eastern Transvaal, where crops such as lucerne generally fail, the value of this grass in these areas can hardly be overestimated.

Acroceras is a grass which is still comparatively unknown, yet it will undoubtedly play an important part in future in the proper feeding of farm animals in the high rainfall areas of the Union.

References.

(1) PASTURE RESEARCH IN SOUTH AFRICA : Progress Report No. 1.

(2) Morrison, F. B.—Feeds and Feeding.

Desert Encroachment over the Karoo.

H. Klintworth, Division of Chemical Services.

OF late considerable attention is being devoted to the danger of desert encroachment over the Karoo, and the Government has considered it necessary to appoint a commission to investigate the problem in all its aspects. One theory, strongly advanced by Dr. Tidmarsh, is that the climate of the Karoo is actually deteriorating.

It is claimed that, not only has the total rainfall decreased considerably during the last 50 years or so, but also that there has been a marked increase in the frequency of hot westernly winds, which dessicate the country and bring about a noticeable encroachment of Karoo veld into the grassland regions towards the east.

Whether this theory can be substantiated by meteorological facts still remains to be seen. There is, however, some evidence that during the past aeons the climate of South Africa has alternated between moist and dry periods—thus, an ancient soil which occurs along the Olifants River in the Cape Province shows clearly that after its deposition the country has passed through at least two complete climatic cycles, each consisting of a period of comparatively high rainfall followed by desert conditions. Moreover, some other soils of the Union exhibit characteristics which are not exactly in harmony with the present climatic conditions, but are more consistent with development under higher rainfall.

It is not unreasonable to believe that, if such climatic changes have occurred in the past, they will continue to do so in the future, and that at present the climate of South Africa tends to become drier. Under normal conditions such a deterioration would probably extend over many thousands, perhaps millions, of years, but the activities of man may accelerate the process beyond all measure. The fate which has overtaken the ancient empires of Persia, Mesopotamia and North Africa is one which we in South Africa would do well to bear in mind, because here we are exposed to exactly the same danger.

Deterioration of Karoo Vegetation.

In a consideration of the deterioration of the Karoo, it is inevitable that most attention should be focussed on the vegetation. In this respect the deterioration is most apparent to the eye, and from the farmer's point of view it is the decrease in the carrying capacity of the veld which concerns him most. However, there are certain aspects of the soil which are fundamental to the issue.

Combined with its natural vegetation and its microflora, the soil forms a biotic, living organism constantly in a state of perfect equilibrium within the limits set by the climate. It is the most costly error ever made by mankind in the past and even to-day, to disregard this fundamental fact and to treat the soil merely as if it were a medium for plant growth to be exploited at will. The "death" of the soil and its "decomposition" by erosion is the inevitable result and man has paid for his transgression by the ruination of millions of acres of once fertile and productive soil.

This living organism remains healthy and stable only as long as there is no interference with any one of its various members. Thus, under the natural vegetation and the natural beneficial exploitations to the vegetation, the

soil maintains its fertility and productivity for many thousands of years. If, however, the natural vegetation is destroyed or replaced by a vegetation of a different type, forces are set in motion which modify the character of the soil, always working towards a new equilibrium in accordance with the altered conditions. The phenomenon of soil erosion is perhaps the most spectacular example of how nature may proceed to establish such a new equilibrium. But, even if no loss of soil has occurred before the new equilibrium is attained, the process is always associated with a decrease in the natural fertility of the soil. The actual productivity may, however, subsequently be increased by the regular application of suitable fertilizers, as is the case in the arable lands of many parts of Europe and America which were originally under forests. In semi-arid regions, such as the Karoo, it is extremely dangerous to upset the equilibrium set by Nature. The low rainfall, combined perhaps with a lower efficiency of the rainfall, may under certain circumstances prevent the re-establishment of a stable equilibrium at any level above desert conditions. The encroachment of the desert in the Karoo and the yearly extension of the Karoo veld into the adjoining grasslands, are clear indications that our farming system has upset the natural equilibrium to a greater extent than is permissible. Let us head Nature's warning and stop the deterioration while there is stil time! Already it may be too late to save many portions of the Karoo!

With all our scientific knowledge we cannot hasten the formation of a soil from original rock material; we, therefore, cannot replace the soil that has been lost by erosion. It is accordingly essential for us to imitate Nature. This we can achieve only after we have learned how Nature proceeds to establish the stable equilibrium whereby the soil is maintained in a living healthy condition.

Groups of Soils and Vegetation.

In broad outlines, we may classify the soils and vegetation of the world in three main groups depending on the climatic conditions:—

(1) Under humid, high rainfall conditions, the natural vegetation is indigenous forest. The soils tend to be rather structureless. Considering the high rainfall of such regions, they do not possess an adequate infiltration rate of water. One would expect such a soil to erode severely, but Nature prevents this by covering the soil with a thick mass of forest litter which acts as a sponge and can absorb inches of water, liberating it slowly to filter into the soil. Stability is ensured only as long as the forest litter protects the soil.

(2) The grasslands occur under a lower rainfall. Moreover, the rain occurs in defined seasons, and periods of high rainfall are followed by periods of low rainfall. The amount of organic matter yearly produced by the grass vegetation is only a fraction of that which is produced by indigenous forest and thus the soils cannot be sufficiently protected against erosion by a layer of organic material on the surface. To maintain stability, Nature therefore had to turn the soil itself into a sponge to absorb the rainwater adequately. Under an exceptionally heavy rain, of course, the grass itself forms a mat over which the excess water can flow without damaging the soil. To transform the soil into a sponge, the grasses were given the ability to form soil aggregates separated by open passages which allow rapid infiltration of water. Thus we get the well-known granular structure of a grassland soil. Of

course, the individual granules of soil must be stable under the action of water; if they disintegrate, the passages would become clogged. In fact, it is remarkable how much pounding they can stand in the laboratory before the aggregates break down.

(3) With a still lower rainfall, when even the hardiest grasses can no longer eke out an existance, the vegetation changes to sparse desert shrubs. Rainfall is so low that water erosion is usually no problem and the soils are again generally structureless. Wind-erosion, however, occurs and is largely intrumental in forming the typical flat plains and steep stony hills of arid regions.

Soil Changes Due to Man.

With these three basic groups in mind, let us now consider what changes in the soil take place when they are brought under cultivation or utilization by man.

In the forest areas the trees have to be cleared, with the result that the litter of organic matter is destroyed. As soon as this has occurred, the structureless soils become exceedingly erodible. After centuries of experience the farmers in Europe have, however, learned how to prevent erosion damage. This is achieved, firstly, by the use of implements and cultural methods by means of which the original structureless soils are arificially given an open crumbly structure, and, secondly, by the development of ley farming. The main objective of European agriculture is, therefore, to improve the structure of the soil and to some extent retain the benificial influence of the original forest litter. A new stable equiilibrium is obtained, in effect, by changing the forests into grasslands, which, as far as the vegetation is concerned, is a retrogressive step in plant succession. Experience has, in fact, proved that when the original soil/plant relationship is disturbed, a new equilibrium can be obtained only at a lower level, i.e. in the direction of increased aridity. This is true, whatever the conditions of the original soil, vegetation and climate.

The soils of perennial grasslands possess an ideal structure which allows rapid penetration of rainwater. The high infiltration rate can, however, be maintained only as long as the whole of the top soil retains the favourable granular structure. If the granules are destroyed on the surface to form even the thinnest film of dense soil, the infiltration rate and the aeration of the soil are seriously affected. Under the natural vegetation and its utilization, the development of such a surface crust is prevented by the presence of decaying organic matter and innumerable burrowing insects which live on it. A surface crust, however, is readily formed when the grassland is subjected to veld-burning, over-grazing or excessive trampling by stock. With less water filtering into the soil, its climate becomes drier and the vegetation tends to change towards more hardy and drought-resistant pioneer types, a degeneration of the veld which is accelerated by selective grazing of the more palatable species. Provided there is still sufficient vegetal cover to protect the soil against erosion, the retrogression can be stopped at any stage by appropriate measures. It will, however, be noted that the new equilibrium is again obtained at a drier level of the soil climate.

The Transkei to-day presents a very instructive example of the progressive deterioration of originally good grassland veld under mismanagement. The original climax grasses have largely been eradicated and replaced by hardier species. This has been accompanied by increased run-off of

rainwater, resulting in deep dongas in nearly every valley where stormwaters can accumulate. At the same time there has been a drying out of numerous springs, although in this region there is no apparent decrease in the annual rainfall. Except for the dongas in the valleys, erosion in the grazing areas does not occur until even the hardier grass types have been eradicated—then sheet erosion becomes rampant until the underlying rock is exposed. The grasses are ultimately replaced by Karoo bushes, which have hardly any retarding effect on the rate of erosion.

The Karoo was mainly under perennial grasses, although these have now mostly disappeared. The undisturbed soils still show traces of the original granular structure. Climatically, the Karoo falls somewhat midway between grassland and desert conditions; the original grasses were probably mainly of pioneer types which could exist under the dry climate.

After over a century of mismanagement there are very few, if any, soils left in the Karoo which are still in their original condition. In practically every case the top soil has either been lost by sheet erosion, or it has been covered with eroded material which has washed down from higher slopes. In either case, the physical condition of the surface soil can only have deteriorated and the soils obviously do not absorb water readily. Deterioration of the soil has followed from—

(1) the practically complete eradication of the structure-building perennial grasses, exposing up to 80 per cent. and more of the surface soil;

(2) trampling of stock; and

(3) the direct impact on the exposed soil by the sun's rays, rain and desiccating dry winds.

These three factors, followed as they are by erosion damage, increase in effective destructiveness every year and continously decrease the soil's ability to absorb the little rain which falls and to retain the water for the use of the plants. In other words, they operate to make the soil less and less capable to maintain plant growth.

Re-establishment of Vegetation.

If under utilization of the veld, the natural soil/plant relationship is disturbed—and a new stable equilibrium is only possible at a more arid level—what vegetation could be established when the original grasses were already of pioneer types? The next stage in the plant succession in the Karoo is composed of Karoo bushes, and these clearly do not cover the soil sufficiently to prevent erosion. Assuming that there has been no significant decrease in the annual rainfall, it should be possible to prevent further degeneration of the veld and re-establish the grass cover over the major portion of the Karoo. On the other hand, there is good reason to believe that in the case of most of the shallow soils of the Karoo, those without a previous substratum, the scale has already been tipped too far and that the most drastic measures will not suffice to preserve them from slowly changing into rocky deserts.

In the semi-arid region such as the Karoo, it is particularly dangerous to upset the natural equilibrium between soil and vegetation, and this applies with the greatest force to shallow soils. As the rain often comes down in heavy torrents, it is hardly possible to prevent some erosion unless the soil is protected by a dense-growing vegetation. In regions of higher rainfall and a more temperate climate, the loss of some inches of top soil by erosion is not so very serious; even if this has occurred, the soil can be stabilized again by planting any of a great variety of different

grasses. A similar procedure may not be possible on shallow soils in semi-arid regions. Here the depth of the soil is of prime importance because the soil must act as a reservoir of water for the plants between rains. One might call the minimum depth of soil which can achieve this purpose and maintain a sufficient density of vegetation to prevent erosion, the "critical depth of soil" under the particular climatic conditions. Then obviously, the loss of soil of only a few inches below the critical depth will result in the death of some of the plants, further denudation and further erosion. There is reason to believe that in many of the shallow areas of the Karoo the soil has already eroded to below the critical depth required for the maintenance of a good grass cover. In such an area it will be useless to attempt rehabilitation under grass. Unless, therefore, it is possible to find a substitute for grass, equally efficient in maintaining soil stability, the chain reaction which was started by the destruction of the original vegetal cover must proceed to its finality until eventually a new equilibrium is obtained—when nothing but the bare rock is left.

On the deeper soils of the Karoo this difficulty does not arise, and if the water can be made to penetrate into the soil, there is no reason why it should be impossible to re-establish the original grass cover. However, during the past ten years or so, a manifestation is appearing on the deep soils which threatens to be equally as dangerous as the erosion on the shallow soils. Bare patches are developing on the veld and they seem to be increasing in size and number every year. These patches are absolutely devoid of vegetation, and the sparse, stunted Karoo bushes around their edges, show how they spread like a cancer into the surrounding veld.

The origin of the bare patches has not yet been investigated, but it is reasonable to assume that the same forces which are causing the deterioration of the Karoo veld generally are here in control also. Poor penetration of rain-water, the desiccating winds and excessive soil temperatures, apparently make it impossible for new plants to establish themselves. It is further highly probable that lack of plant-growth is followed by an increase in the concentration of solube salts which may later make all plant growth impossible. The bare patches thus merely mark the final stage of the deterioration and herald the approach of true desert conditions when ultimately the whole of the Karoo will be devoid of vegetation.

A comprehensive program of research into the origin and methods of reclamation of these bare patches is a matter of extreme urgency.

The shallow Karoo soils which occur on the dolerite hills and ridges of the Karoo fall into an entirely different category. Although the soils may be only a few inches deep, the underlying dolerite is fairly well decomposed to a considerable depth and is somewhat penetrable by grass roots. Furthermore, because of the numerous boulders and stone outcrops, the dolerite hills, per equal area of surface soil receive about twice as much rain as the normal veld, and the stones also provide shading for the soil. As a result of these factors the water balance of the dolerite hills is infinitely more favourable for plant growth than the rest of the Karoo, and many of them still carry good stands of grass. There is, in fact, good reason to believe that the origin of the ground water in the Karoo lies in the rain water which falls on the dolerite hills and penetrates to beyond the reach of plant roots.

Over-grazing on these dolerite hills, with resultant degeneration of the vegetation and soil surface, has increased the run-off and is one of the causes of soil erosion on the shallow shale soils lower on the slopes. If

the theory that the underground water of the Karoo originates in the dolerite koppies is correct, then increased run-off at the same time is one of the reasons for the rapid depletion of the underground water supplies. Particular attention should, therefore, be paid to the preservation of the vegetation and soil on the dolerite hills in any scheme for the regeneration of the Karoo.

There can, therefore, be no doubt that the present system of veld-utilization in the Karoo, actually encourages the approach of desert conditions. Whether this is accompanied by a decrease in the rainfall is a moot point. If it should be established that the climate is actually deteriorating, then this may be explained by the dissipation of the sun's energy which, instead of being used (as Nature intended) for the production of plant material, is wasted in the form of heat and wind.

Any deterioration which has taken place in the Karoo is therefore capable of explanation on the basis of a faulty system of land-use. The extremely delicate equilibrium between vegetation and soil in a semi-arid area has been upset. If the original vegetal cover could be re-established—and this may be impossible on certain soils—both the productivity and the climate could be brought back to the normal.

Assuming a deterioration of the climatic conditions, it will probably be futile to attempt regeneration of the grass cover on isolated farms or even over whole districts. It will require far-reaching rehabilitation measures over the whole length and breadth of the territory before good results can be expected.

Useful Bulletins.

The following are a few of the bulletins obtainable from the Editor of Publications, Department of Agriculture, Pretoria, post free and prepaid at the prices indicated:—

Poultry Farming.—Bulletin No. 241, by Dr. J. J. Bronkhorst. Price 1s.

Poultry Houses.—Bulletin No. 257, by C. L. Marais and N. J. van Straaten. Price 1s.

Turkeys.—Bulletin No. 264, by E. F. Lombard and Prof. A. M. Gericke. Price 3d.

Classing of Poultry or the Culling of Non-Producers.—Bulletin No. 207, by P. J. Serfontein. Price 3d.

The Small Hive Beetle.—Bulletin No. 220, by Dr. H. E. Lundie. Price 3d.

The Production and Handling of Cream.—Bulletin No. 219, by P. Toens and P. du Preez. Price 3d.

The Preparation of Skins for the Market.—Bulletin No. 263, by P. D. Rose. Price 3d.

Gerbille Control.—Bulletin No. 233, by D. H. S. Davis and A. D. Thomas. Price 3d.

Miscellaneous D.D.T. Studies With special reference to Some Common Agricultural Pests.—Bulletin No. 276. Price 3d.

Setaria Grasses.

J. P. Botha, Officer in Charge, Athole Pasture Research Station, Ermelo.

THE setaria grasses are well known in South Africa, fourteen or fifteen species, including both annuals and perennials, being found in the Union.

The annual species, which is generally found in cultivated lands and is sometimes used in conjunction with sweet grass (*panicum laevifolium*) for hay, is the type with which farmers are most familiar. The most common species in the mist belt of the eastern Transvaal are the indigenous perennial *Setaria nigrirostris,* which thrives best in fertile soils

FIG. 1.—First cutting of Setaria P 1193 ; 1943-44 season.

and is therefore most prevalent alongside wattle plantations, or in fields which were once under wattle, and the taller plants, identified as *Setaria sphacelata.* These grasses are exceptionally palatable, and if within reach of stock, they seldom mature and run to seed. Indeed, the presence of these grasses, and more particularly of *Setaria sphacelata,* is usually an indication of a well-managed veld.

In East Africa several species occur which are very closely related to our indigenous setaria grasses. In 1937 a number of these grasses was collected and transplanted at the Rietondale and Prinshof Research Stations at Pretoria. In September 1939 small quantities of roots were obtained from these institutions and planted in plots at the Athole Research Station, which is situated in the mist belt, where their luxuriant growth soon attracted attention.

Although the plants differed as regards appearance, habits, stem thickness, susceptibility to smut, etc., their infloresence showed such marked similarity, that the majority were identified as *Setaria sphacelata.*

Upon arrival at the Prinshof Research Staton, each specimen was furnished with an identification number and it has become customary to distinguish the different grasses by their Prinshof numbers. Thus, for example, we speak of *Setaria sphacelata P*1185, *Setaria sphacelata P*1190, etc.

Most of the grasses adapted themselves excellently to local conditions. A few proved very susceptible to smut and consequently were eliminated. Others again had proportionately too little foliage and too much stem to qualify as good fodder crops. Several of these grasses were leafy, showed a high degree of immunity to smut and were capable of high yields. Three of these species, viz., P1185, P1193 and P1194, were selected as the best and established on a larger scale. All three are perennial, have the same habits and attain a height of approximately six feet six inches when in full bloom. Moreover, all three are thick-strawed, P1193 being the finest and P1185, the coarsest.

Method of Establishment.

Setaria grasses may be established either by means of seeds or bv means of roots. They seed well and if harvesting is carried out at the correct times, the viability of the seed is satisfactory. It is

FIG. 2.—Second cutting of Setaria P 1193; 1943–44 season.

necessary to prepare seed-beds of fine tilth preparatory to sowing the seeds. Light harrowing followed by rolling is sufficient for covering the seed. Seed may also be mixed with fertilizer, fine compost or kraal manure and planted by means of the fertilizer hoppers of an ordinary maize-planter. The latter method of planting may be recommended, since it renders possible the control of weeds with an ordinary cultivator.

Unfortunately, the young plants are not very resistant to the weeds commonly found in cultivated lands and the best results are therefore obtained on relatively newly ploughed ground or on lands which have been weeded for the purpose.

Roots are less fastidious, but they also do not thrive on weed-infested lands, so that it is definitely advisable to use lands which are not yet overrun by weeds, or to clear the lands of weeds, before planting.

Naturally, the method of establishment by means of roots entails a much higher outlay than the other method. At this institution the labour costs alone (including rations) amounted to £3. 9s. 4d. per morgen. It is not worth while establishing roots in old, depleted lands which are no longer capable of producing any other crops, unless the fertility is enhanced by the application of kraal manure, compost or other suitable fertilizers. On reasonably fertile soils, however, the establishment of roots is a paying undertaking and better profits are obtained than by the establishment of a good many of the annual crops which are at present cultivated in this area.

Slips for transplanting are obtained by breaking up the large tufts. It is not advisable to cut the slips too small. The larger the slip the better its resistance to weeds, especcially during the first season. Slips may be planted in rows 3 to 3½ ft. apart and from 12″ to 18″ in the

FIG. 3.—A fine stand of Setaria P 1193 at the Athole Research Station.

rows. It is essential for a portion of the slip to protrude above the surface. The roots cannot be placed in the planting furrow and then ploughed under, as in the case of certain other grasses. In order to ensure the growth of a large percentage of the seedlings, transplanting must be undertaken only when the soil is thoroughly soaked.

Time of Planting.

The most suitable time of the year for planting or sowing Setaria grasses is from September to December, after good rains. Roots may, however, still be planted as late as January, although when this is done, no hay crop can be expected during that season.

Soil and Rainfall.

Locally the Setaria grasses are successfully cultivated on a sandy loam soil. It is, however, a well-known fact that the grasses also thrive on other types of soil.

The grasses do well in areas with a relatively high summer rainfall. An annual rainfall of 30 to 45 inches ensures successful cultivation in the eastern Transvaal. In all probability the grass would thrive even if the rainfall were slightly lower.

Condition During the Winter.

All three are summer grasses and they cannot therefore be expected to remain green during the winter as well. Under local conditions, however, there is usually a trace of verdancy during the winter months, particularly during the first winter after the establishment of the grass.

Hay.

All three Setaria grasses have been successfully utilized for hay. The best and most palatable hay is obtained if the grass is mown during the early stages of growth, i.e., when it has attained a height of approximately two feet to two feet six inches, or as soon as the first seed haulms appear. If the grass is allowed to reach the fullbloom stage first, the stems become thick and hard and a coarse hay is obtained. This applies particularly to P1185 and P1194.

FIG. 4.—Setaria P 1185 on a contour embankment.

At this stage difficulty is sometimes experienced with the mowing of the grass. Only a mowing-machine with a sharp knife and one which moves at a comparitively high speed is suitable for mowing a good stand properly. Horse or tractor-drawn mowers are more effective than those drawn by oxen.

Setaria P1193 is much finer-strawed than the above-mentioned two, is easier to mow and gives a better quality hay, especially if mowing is carried out late when the grass has already run to seed. Unless the grass is mown during the young stage, difficulty may be experienced with the drying of the hay. It is sometimes necessary to leave the grass on the lands for three to four days, before the thick stems are sufficiently dry for packing into stooks. In areas like these which are subject to protracted spells of misty weather, it is definitely detrimental to leave

hay on the land for any length of time before packing into stooks. Freshly-mown grass is. however, less liable to serious damage by mist and rain. On several occasions reasonably good hay was made from grass which was exposed to mist and rain for eight to ten days after mowing. Serious damage is caused if it rains when the grass is already half dry or immediately before it is ready to be raked up. After continuous misty weather at this stage the hay is usually a pale, unpalatable product. When hay trestles are used, the grass can be raked up much earlier than when the stooks have to stand on the ground. These trestles ensure effective aeration of the stooks, thus lessening the danger of overheating of the thick-stemmed grasses, even during periods of continuous rains.

Hay Yields.

Notwithstanding difficulties which are sometimes experienced in the mist belt with the preparation of hay, the Setaria grasses give such high yields that their establishment is still worth while. Indeed, the very fact that they grow so luxuriantly and produce so much green material gives rise to the difficulties in regard to the drying of the hay.

FIG. 5.—The heaps indicate the high yield of Settaria P 1193 at the Athole Research Station.

The hay yield on a land planted during September and harvested for the first time at the end of March, was 10·56 tons per morgen. During the subsequent season the land could be harvested twice (see figs. 1 & 2) and the yields were 8·53 and 6·40 tons per morgen, respectively, or a total of 14·93 tons per morgen. The third season was characterized by a serious drought which caused considerable damage to the grass. Nevertheless, a first cutting of 4·85 tons per morgen was possible, with the further prospect of a second cutting.

Fertilization.

It is perhaps necessary to examine the fertilizer costs involved in the above hay production.

Before the grass was established, the land received an application of 30 tons of compost per morgen. During the following season 200 lb. superphosphate and 200 lb. ammonium sulphate were applied per morgen and during the third season 200 lb. of ammonium sulphate were applied per morgen. The total application per morgen over a period of three years was, therefore, 30 tons compost, 200 lb. superphosphate and 400 lb. ammonium sulphate. The costs entailed can be calculated as follows:—

30 tons compost @ 2/- per ton	£3. 0. 0.
200 lb. superphosphate @ £5.1.0. per ton.	£0.10. 1.
400 lb. ammonium sulphate @ £17.15.0. per ton.	£3.11. 0.
Total	£7. 1. 1.

During the above period 30·34 tons of hay per morgen were produced, bringing the fertilizer costs to 4/4½d. per ton of hay. The above costs include the value of the fertilizers only and not the costs of transport and spreading. If the latter are added, the costs per ton of hay will be slightly higher than those given above. On the other hand it must be borne in mind that only the first cutting during the third season was included. No additional fertilizer is used for the second cutting, so that the costs per ton of hay on the total yield for the three years will be lower than indicated above.

Palatability.

Setaria grasses are exceptionally palatable and are eagerly eaten by cattle and sheep. In the young stage, i.e., at a height of approximately 18 inches, it furnishes exceptionally attractive grazing for dairy cows. It is particularly valuable during autumn when the aftermath, after the hay has been mown for the last time, grows out rapidly and offers attractive grazing. The palatibility of the hay depends largely upon the stage at which it is cut. As a rule, the most palatable hay is made when the grass is young, i.e., up to the flowering stage. Hay which is cut later contains a relatively high percentage of hard stems and has an unattractive appearance, but the eagerness with which even this quality of hay is eaten, is remarkable.

Silage.

As a silage crop these grasses are particularly valuable. They comply excellently with the primary requirement of a good silage crop, viz., a high yield. In addition, Setaria silage, properly made with molasses, is of good quality. Quite the most important attribute of this grass as a silage crop, however, is its permanent nature. A crop which can be utilizerd for four or five successive years without ploughing or planting, ensures a considerable saving in cultivation costs and, for this reason alone, deserves special attention.

Use in Rotational Systems.

The Setaria grasses have a simple root system and there is no danger of their becoming a nuisance on cultivated land. They can be ploughed out comparatively easily and are therefore suitable for use in rotational systems. They are particularly valuable in rotational systems where provision has to be made for a relatively long period under grass.

Other Uses.

Setaria grasses can be very advantageously cultivated on all odd pieces of land which are normally left unused on the farm. They are eminently suitable for cultivation along contour banks and contour strips

on cultivated lands. The grass not only serves the purpose of stabilizing the banks and preventing erosion, but also produces an appreciable yield on soil which would otherwise have been unused. Contour banks and strips with three rows of Setaria P1185 gave the following yields of dry hay per mile at this institution:—

Year.	*Tons per Mile.*
1942-43	3·53
1943-44	5·15
1944-45	3·73

The above yields were obtained from a single cutting annually. In each case the aftermath was grazed down during the autumn and winter. These strips of grass received no fertilizer whatever.

At this institution strips of grass are sometimes utilized in cultivated lands instead of contour banks. Three rows of Setaria planted along the contour at distances of three feet apart, are a valuable means for preventing erosion. On sloping lands, however, such strips are not adequate, and a sound scheme is to alternate the strips with contour banks.

The Setaria grasses are not yet specially grown by our farmers, but ought to constitute a valuable addition to our fodder crops in future. From the point of view of the conservation of the fertility of our arable land, the value of a perennial grass such as this cannot be over-estimated.

Wool, the Wonder Fibre:—

[*Continued from page* 716

removes all lumps and curls and the menders sew in all broken threads, etc.

Dyeing and Finishing.

The final processes are those of dyeing and finishing.

These processes are briefly as follows: After the fabric has been steamed to allow the threads to set, it is thoroughly washed with soap and water to remove all grease marks. Then all stray fibres are clipped, and the fabric is dyed, (i.e. if there has been no previous dyeing), and pressed. Thereupon, it is made up into rolls and usually sent direct to the wholesaler who, in turn, sells to the retailer.

Felting.

It is of interest to know that fine merino wool may be processed into cloth without first being spun into yarn. The "felt" so obtained is generally used for making felt hats, wool washers, etc., and during the last world war for making army blankets. It is usually made from films of wool superimposed in layers after the carding process. When the desired thickness is obtained they are milled into a compact mass brought about by pressure and friction in a soapy solution which serves as a lubricant.

The Production of Nicotine Sulphate from Waste Tobacco.

LARGE quantities of nicotine sulphate or nicotine are used annually in South Africa for the control of soft-bodied insects, such as aphids, poultry lice, stomach worms in sheep, and for fumigating green-houses. In the near future more nicotine will probably be used unually, not only due to the expansion of the existing uses, but also for the control of other insect pests, for instance, for the control of the codling moth and for dips against ticks.

All the nicotine used in South Africa is imported from America, Germany, East Africa and other countries. The pre-war retail price of the imported article was 3s. 6d. per lb. or £1 10s. a gallon of 40 per cent. nicontine bound as nicotine sulphate, but at present the product is sold at round about 8s. to 10s. per lb. and in some cases at 2s. 6d. an ounce.

The Chairman of the Central Co-operative Tobacco Company maintains that, in normal times, about one million pounds of tobacco are destroyed annually by the different co-operative societies owing to the unsuitability of the tobacco for the manufacture of snuff, smoking or chewing tobacco.

An investigation was therefore undertaken by the Division of Chemical Services with the object of converting the tobacco waste, from the different tobacco co-operative societies, factories and farmers engaged in the tobacco trade, into nicotine sulphate. Nicotine sulphate is urgently needed, but at present scarcely obtainable in South Africa. The results of this investigation are published in Science Bulletin No. 278, obtainable from the Division of Chemical Services, Pretoria (in English only), at 1s. per copy.

A summary of the findings is given below for those interested in the subject.

Of all the different species of tobacco, only *Nicotiana rustica* and *Nicotiana tabacum* are of any importance as sources of nicotine. In South Africa the main species grown for smoking purposes is *Nicotiana tabacum.*

Nicotine is present in the entire tobacco plant, the largest amount being concentrated in the mature leaves. The stem and roots contain very little. The nicotine content of the plant is also influenced by various factors such as climate, fertilization, maturity and special treatment during the growing period.

In addition to nicotine, the plant also contains other related alkaloids; for example, South African tobacco contains an average of 2·4 to 2·6 per cent. nicotine and 0·18 per cent. nor-nicotine. On the other hand, the South African wild tobacco, *Nicotiana lanca,* contains only anabasine (0·3 per cent.) as a steam volatile alkaloid.

The heavy tobacco types contain from 3 to 5 per cent. nicotine, and the lighter types from less than 1 to 2 per cent. Waste tobacco contains an average of 1·8 per cent. nicotine.

The best nicotine yield per morgen is obtained by planting *Nicotiana rustica* six inches apart in the rows. The heaver snuff tipes produce the highest yield of nicotine per morgen if planted 12 inches apart. It has also been found that in South Africa *Nicotiana rustica* can be cultivated with a nicotine content of 5·0 to 6·0 per cent. for the entire plant, and the heavier types with a nicotine content of 5·5 to 6·0 per cent. in the leaves or 3·5 to 4·5 per cent. for the whole plant.

Continued on page 750.

A Leafspot Disease of Pears.

A. J. Louw, Western Province Fruit Research Station.

IN the Western Cape Province some varieties of pears are often subject to severe leaf scorch during summer. Although climatic conditions and spray injury are directly responsible for this damage, it is very often aggravated by the presence of leaf spots of the so-called white spot disease. This disease, which is caused by the fungus *Septoria piricola* Desm., was investigated in some detail during the seasons 1940-41 and 1941-42, when it was for the first time noticed to occur severely in parts of Elgin and Somerset West.

The Disease and its Cause.

On the leaves, the disease causes more or less circular spots approximately 2 to 3 mm. in diameter (Fig. I*a*.). In the central whitish-coloured portion of the lesion, the pycnidia or summer spore stage (Fig II*a*.) of the casual fungus can usually be seen with the naked eye as minute black specks.

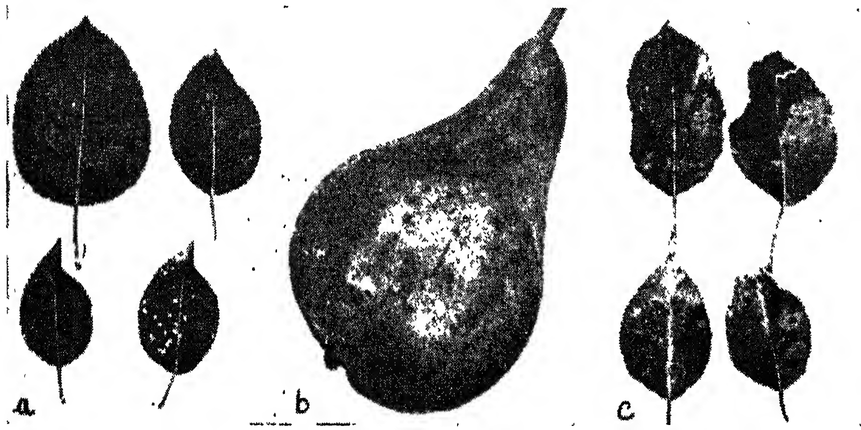


FIG. 1 (*a*). Pear leaves with the white spots caused by the fungus *Septoria piricola* Desm; (*b*) Spots caused by the same disease on fruit of Beurre Bosc pear; (*c*) infected leaves sprayed with arsenate of lead, showing confluence of the individual lesions and and scorching of the leaves.

The thread-like summer spores contained in these fruiting bodies are responsible for the spreading of the disease during the growing season of the tree. In winter, however, another type of spore—the winter or ascus stage—develops on the infected leaves of the previous season which lie on the ground. The winter or ascospores set free from the overwintered pear leaves during the spring, initiate the first outbreaks of the disease each season.*

* During the spring of 1940 and 1941 fruiting bodies of *Mycospharella sentina*, which was first shown by Klebahn (1908) to be the ascosporic stage of *Septoria piricola* Desm., were found in abundance on overwintered pear leaves in orchards at Elgin. Cultures made from these spores on agar media produced conidia of *Septoria piricola*, and inoculations on pear leaves caused the typical white spots with pycnidia. On the 17th October, 1941, the spores of *Mycospharella sentina* were trapped in abundance on vaselined slides placed over the dead pear leaves bearing the fruiting bodies. The first major outbreak of the disease in that year was recorded on the 6th November and was probably initiated by the ascospore discharge of the 17th October. No leaf spots were observed prior to the maturation of the perithecia, and it was concluded that, at Elgin, the ascosporic stage constitutes the principal primary inoculum.

In the presence of moisture, the spores germinate on the surface of the pear leaves, the germ tubes penetrating into the interior of the leaf. In artificial inoculations, infection penetration has been observed to take place by way of the stomata of the leaf. It is not certain whether the germ tubes can also penetrate the leaf cuticle directly. The time that elapses between infection penetration by the fungus and the appearance of the leaf spot varies from 15 to 21 days. In the orchard new outbreaks of the disease will, therefore, not be noticed before 15 to 21 days after the rainy periods during which the infections occur. In artificial inoculations with ascospores, this incubation period of the disease was appreciably shorter than when the summer spores were used as inoculum. Temperature, however, on account of its influence on the rate of germ tube growth, is probably the principal factor governing the duration of the incubation period.

Damage Caused by the Disease.

The dead spots caused by the disease in the leaves represent a direct reduction of the functional leaf surface of the tree. At these spots the transpirational water loss too, is higher than that of healthy leaf tissue and this causes infected leaves to scorch very readily during dry and hot weather. It was experimentally shown that these leaf spots may favour injury by spray materials.

Artificially inoculated potted pear trees, after they had become severely spotted by the disease, were sprayed with a lead arsenate mixture as commonly used for the codling moth until recently. Similarly infected trees were left unsprayed while a third series of healthy trees was also sprayed with the arsenate mixture. The foliage of the diseased trees developed very severe leaf scorch. The individual leaf spots became confluent and large portions of the leaves necrotic, while diseased leaves that were left unsprayed showed only the original lesions caused by the disease but no spray injury. The uninfected leaves that were sprayed remained entirely unblemished.

The direct damage caused by the disease, and the leaf scorch and premature leaf-fall sometimes resulting from it, may lead to a considerable reduction in the functional capacity and food reserves of the tree.

Considering that fruit bud formation and the crop in general are largely influenced by the food reserves, the disease may be an important limiting factor in the productivity of the tree. Data taken at Elgin showed that trees on which the disease has been properly controlled by spraying, developed more than twice the amount of fruit buds found on untreated trees. Counts of the blossoms later in the season showed that the fruit buds of healthy trees had, on the average, more blossoms per bud than the fruit buds on trees which had suffered severely from the disease in the previous season.

Apart from the indirect damage, the disease sometimes also affects the fruit, on which it causes small sunken spots usually not larger than 1 mm. in diameter (Fig. 1*b*.). This disfigurement decreases the commercial value of the fruit. In February, 1942, the infection of the fruit of the Beurre Bosc variety in one orchard at Elgin was estimated at 75 per cent. On Beurre Hardy trees in the same orchard no fruit infection was noticed. This was probably due to a difference in susceptibility of the two varieties.

Varietal Susceptibility.

In China this leaf spot disease has been reported to attack the native sand pear (*Pyrus serotina*) very badly. According to Wenzl (1935), no pear variety appeared to be quite immune to it in Austria,

and the varieties most resistant to pear scab were highly susceptible to the leaf spot disease. Esmarch (1935), also from Austria, mentioned some resistant pear varieties among which Vereins Dechants (which is the same as Doyenne du Comice) is the only grown commercially in the Union of South Africa.

To obtain information on the relative susceptibility of some of the pear varieties grown locally, data were taken on the incidence of the disease in a mixed orchard at Elgin in February, 1941. The results are given in Table I.

TABLE I.—*The Occurrence of White Spot Disease on different pear varieties. Expressed in percentages of leaves with different degrees of infection.*

	Percentage leaves of					
Disease spots per leaf.	Beurre Bosc.	Beurre Hardy.	Bon Chretien.	Doy. du Comice.	Packhams Triumph.	Winter Nelis.
0	1	1	4	100	100	100
0–15	8	50	61	0	0	0
15–40	28	33	29	0	0	0
40–80	32	13	4	0	0	0
80	31	3	2	0	0	0

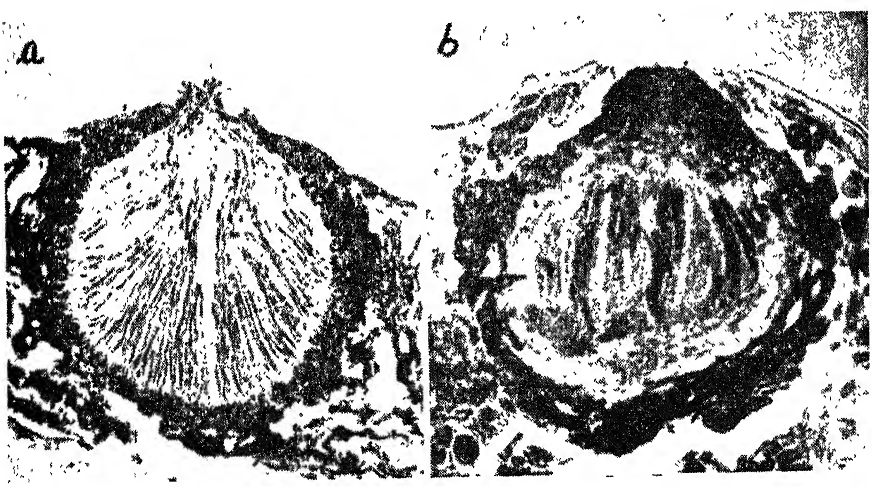


FIG. 2 (*a*). Cross-section of the summer stage of the fungus causing white spot disease, showing the thread-like summer spores in the spore fruit (Magn. approx. 350 X). (*b*) Cross-section of the winter or ascus stage of the fungus causing white spot disease, showing the ascospores arranged in bags inside the spore fruit. (Magn. approx. 350 X).

Of the six varieties listed, the Beurre Bosc proved to be the most susceptible. Doyenne du Comice, Packham's Triumph and Winter Nelis on the other hand appeared to be highly resistant.

Control.

During the 1940-41 and 1941-42 seasons spraying experiments for the control of white spot disease were carried out at Elgin on the Beurre Hardy variety. The 1940-41 experiments were made to determine the relative value of sprayings at different times. For this purpose different spray programmes consisting of lime-sulphur applications at

the stages indicated in Table II, were tested. The strength of the lime-sulphur mixture used at the bud-bursting stage was 1 gallon in 20 gallons of water, and 1 in 100 at the later stages.

TABLE II.—*The effect of lime-sulphur sprays at different stages of bud development on the incidence of white spot disease on Beurre Hardy pear trees at Elgin during the* 1940-41 *season.*

Bud-burst	Green-cluster	Petal-fall	Post-blossom	Percentage infected leaves on :			Number of spots per 100 leaves on :		
11/9/40	17/10/40	5/11/40	22/11/40	6/12/40	20/12/40	20/1/41	6/12/40	20/12/40	20/1/41
+	+			4·4	3·1	31·4	10	34	75
+	+	+		2·7	2·7	4·3	4	6	8
+	+	+	+	0·6	0·1	2·4	1	1	1
	+			4·1	4·3	30·6	13	11	75
	+	+		2·1	1·3	14·8	2	11	38
	+	+	+	0·8	0·5	1·1	1	1	2
		+		11·5	21·9	17·9	31	55	43
		+	+	6·8	10·2	15·4	21	23	42
			+	15·1	25·9	55·9	32	67	184
		check		24·3	36·6	55·0	61	84	202

The disease was very satisfactorily controlled by a spray progamme consisting of consecutive applications at the "green-cluster", "petal-fall" and "post-blossom" stages. The application at the "bud-burst" stage had an appreciable effect on the disease when it was applied alone, but as an additional spray in the above spray progamme it provided very little extra control.

The fact that the concentrated lime-sulphur treatment at the "bud-burst" stage had so little effect on the disease substantiates the view that the disease does not overwinter on the tree, for in that case some eradicative action of the spray could have been expected. Control was only obtained by protective spraying after an appreciable leaf surface had become exposed.

Separately, the sprayings at the "green-cluster" and "petal-fall" stages had the greatest effect on the disease. The "post-blossom" application, when applied alone, had very little effect on foliage infection as so much of the foliage had already become infected by that time. The "post-blossom" spray, however, considerably improved the control of the disease when preceded by the applications at the "green-cluster" and "petal-fall" stages. Furthermore, as the young fruits are also covered by the spray material during the post-blossom period, spraying at this stage provides a direct protection to the crop and should prove particularly valuable where infection of the fruit is liable to occur.

In the 1941-42 season comparative spray trials with different fungicides were carried out on the Beurre Hardy variety at Elgin. In addition to the commercial fungicides, lime-sulphur mixture, wettable sulphur and Verderame (copper oxychloride), the trials also included the zinc-lime mixture generally used as a corrective for zinc deficiency, and Orthol K—a light to medium type of spray oil which at that time was commonly used for the control of the codling moth. The results of these tests are given in Table III.

Table III.—*Leaf spot infection of (a) Beurre Hardy pear trees at Elgin treated with different sprays, and (b) the Beurre Bosc variety at Bien Donne, Groot Drakenstein, sprayed with summer oil emulsion during the* 1941-42 *season.*

Treatment (Spray mixtures per 100 gals. of water).	Percentage infected leaves.	Number of spots per 100 leaves.
(*a*) Lime-sulphur—1 gal.	10·5	20
Wettable sulphur—5 lb.	14·5	40
Copper oxychloride—5 lb.	1·2	2
Zinc sulphate—5 lb. and hydrated lime—5 lb.	22·2	38
Summer oil emulsion—1 gal.	18·0	26
Check	89·5	1814
(*b*) Summer oil emulsion—1 gal.	12·7	19
Check	49·6	136

Of the commercial fungicides, the copper spray gave the best control, followed by lime-sulphur and wettable sulphur. Very good control was also obtained with the zinc-lime and oil sprays. It follows, therefore, that where these sprays are applied for their specific purposes during the period in which spraying for white spot is required, no special measures need be taken for the latter.

Further evidence of the suppressive effect of oil sprays on white spot disease was obtained during the same season at Bien Donne, the experimental farm of the Research Station, where part of an orchard of Beurre Bosc trees which had been oil-sprayed in the course of codling moth experiments, was practically free from leaf spot disease while the unsprayed portion was badly infected. Table III (*b*) gives some data on the relative incidence of leaf spot on the sprayed and unsprayed trees in this orchard.

This effect of oil sprays on the disease offers a possible explanation for the almost complete absence of the disease in Ceres and other inland areas where, until recently, summer oil was much resorted to in the campaign against the codling moth. With the introduction of D.D.T. sprays and the exclusion of summer oil sprays from the codling moth spray programme, white spot disease may be expected to appear more generally and severely in future.

Summary.

1. The white spot disease of pears (*Septoria piricola* Desm.) may cause serious damage to pear trees in the Western Cape Province in some seasons by directly injuring the foliage and fruit and by aggravating leaf scorch caused by weather conditions and spray materials.

2. Varieties differ in susceptibility to the disease, the Beurre Bosc being the most susceptible and Doyenne du Comice, Packham's Triumph and Winter Nelis highly resistant.

3. Primary infections each season originate from the ascosporic stage of the casual fungus [*Mycosphaerella sentina* (Fr.) Schr] which occurs on overwintered pear leaves in the Western Cape Province during the spring months.

4. The disease can be effectively controlled by four sprayings with a suitable fungicide at the following stages:—

(*a*) Bud-burst,

(*b*) green-cluster,

[*Continued on page* 743.

Rhizoctonia Stem-Rot of Carnations.

E. E. Schaefer, Division of Botany and Plant Pathology.

THERE are about a dozen different diseases that attack carnation plants in South Africa, but the one causing by far the most serious economic losses in the Transvaal is the stem-rot disease caused by a fungus, *Rhizoctonia* sp.

The trouble is first noticed when the plant loses colour. The leaves soon whither and within a week or two the whole plant dies. When an attempt is made to remove such a plant, the stem often breaks off at ground-level and the roots remain in the soil. When examined closely, small particles of sand and plant material may commonly be seen attached to the broken stem by short and almost invisible fungous threads.

When examined under a microscope the rotted base of the stem is found to contain a fungus. This fungus, which is itself a small plant, lives as a parasite in the stem, and by destroying the tissues causes the stem to rot and the plant to die.

Once a plant has started to wilt, the disease has usually developed to such an extent that it is too late to cure it. By this time the fungus has already penetrated deeply into the stem, where it cannot be killed by fugicides without killing the plant as well. If an infected plant is treated in the very early stages of the disease, however, it may be cured by watering it with a fungicide. This is, however, not practical in commercial plantings.

The particular fungus concerned does not live on carnation plants alone, but is present in various types of soil where it lives on dead vegetable matter derived from different plants. For this reason it is practically impossible to get rid of the fungus by crop rotation.

Although no method has yet been evolved that will cure a severely infected plant, and although the fungus is present in very many soils, much can nevertheless be done to prevent the disease.

Rhizoctonia fortunately belongs to that group of fungi which are incapable of attacking perfectly healthy plants. Prevention of the disease therefore lies in growing only healthy carnation plants. Admittedly, it is impossible to know merely by looking at a plant whether it is healthy enough to resist the disease, but it is obvious that a plant growing under good conditions will be healthier, and therefore more resistant, than one growing under poor conditions. The aim of the grower should therefore be to grow carnations under the best possible conditions. It has been found from general observations that the following conditions play a most important part in the prevention of *Rhizoctonia* stem rot:—

(1) The soil should have good natural drainage. In soils where the drainage is not quite adequate, plants may do well for a time, but there is always the risk of stem-rot, especially after periods of heavy rain. On such soils the risk will be considerably lessened if the plants are grown on ridges and not in furrows. Excess rain water is then less likely to stand around the stems for long; and irrigation water can be led between the rows without coming in direct contact with the stems.

(2) Plants should not be over-watered. Although carnation plants may tolerate frequent waterings when grown on well-drained soil, over-watering is harmful if the drainage is at all defective. Great care in

watering is therefore needed. For example, this should not be done twice a week merely because a neighbour has found that his carnations do well if watered twice a week. To judge whether water is needed, take a handful of soil from a depth of about four inches, compress this in the hand and, if it remains compacted, the soil has ample moisture and watering is not necessary.

(3) The plants should not be watered during the latter part of the day.

(4) Carnations should not be planted to deeply. Only the roots, and not the main stem and lower parts of the branches, should be under the soil.

(5) The plants should be set out either on level or on very slightly sloping land. If it is necessary to use ground that slopes steeply, they should be set out on the contour. If this is not done, rain and irrigation water will soon wash soil over the major portion, or the whole of the main stems. This is especially the case on sandy soils, and is often the reason for the high incidence of the disease under such circumstances.

(6) The soil should not be acid. If the soil is inclined to be acid, this may be corrected by the addition of agricultural lime applied at the rate of about 2 ozs. per square yard a few months before planting.

(7) The soil should not be excessively manured. On such soils the plants are inclined to become too succulent and, in this condition, they are more susceptible to attack by the fungus.

Rhizoctonia stem-rot may still appear among carnations despite the above precautions, but growers will be gratified to find to what extent the trouble can be lessened, and to learn on what different soil types carnations may be grown successfully.

Although stem-rot may cause serious losses, there is consolation in the fact that the casual fungus usually remains localized and does not extend into the branches. For this reason cuttings or slips may be taken from diseased plants, provided they are taken well away from the rotted stems and are not directly contaminated by the hands or cutting instruments.

A Leafspot Disease of Pears:—

[*Continued from page* 741.

(*c*) petal-fall, and

(*d*) post-blossom, about a fortnight after petal-fall.

5. Apart from the standard copper and sulphur fungicides, the disease is also satisfactorily controlled by zinc and summer oil sprays; therefore, these sprays can replace the fungicidal sprays where they are applied at any of the above spray periods as a cure for zinc deficiency or for combating codling moth, respectively.

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Information on Beekeeping

BEEKEEPING is the most neglected agricultural industry in South Africa; and as a result it is estimated that honey to the value of £4,000,000 is lost to the Union every year.

This general neglect can be traced to the popular fear of the sting of the honey-bee and to the fact that the fundamental principles of bee-culture are not generally understood.

Bees, to be profitable, must be housed in modern movable comb hives and receive intelligent care. Although it is essential that certain things must be done at the right time, bees do not call for that constant daily attention that poultry-keeping demands.

The honey-bee's greatest service to mankind is as an agent in cross-pollination. Out of 220 different varieties of our principal orchard fruits which have been tested, 165 have been shown to be positively self-sterile. In these cases cross-pollination must be provided for if any fruit is to set. *"Busy bees bring bending branches"* is literally true and on this account all progressive fruit-growers should interest themselves in bee-keeping.

Marketing.—The importations of honey from overseas into the Union is prohibited, so South African producers have the honey market to themselves. There is a profitable market overseas should the South African market become glutted.

The Modern Hive.

The modern hive has the following advantages over the old primitive box hives which are unfortunately so common in South Africa:—

(1) The honey produced in the frames of the modern hive can be extracted from the combs by means of a machine called a „honey extractor ". The empty combs can then be returned to the bees to be refilled. Combs have been kept in use in this manner for over 40 years. Not only is a more wholesome product secured by this system, but a large amount of honey is conserved, as bees have to consume from 5 to 20 lb. of honey, to produce one pound of wax or comb.

(2) With the modern hive, swarming, or the natural division of the colony, can be controlled. A division of the working force at a critical time results in little or no surplus honey for the beekeeper.

(3) In a modern hive the colony can be requeened systematically. The queen-bee is the mother of all the other bees in the hive; therefore the ability of a colony to gather a honey crop depends largely upon her fecundity. A good queen lays over 2,000 eggs a day at the height of the egg-laying period; old queens are not so prolific.

(4) In modern hives weak colonies can easily be united, and many other manipulations performed, which will ensure that there will be a maximum number of bees ready to gather the crop, when the main honey-flow of the locality commences.

(5) In the modern hive, disease of the brood can be detected and controlled, which is utterly impracticable when bees are housed in boxes or other primitive hives.

Type of Hive to Adopt.—The 10-frame Langstroth hive is the standard hive in America, Australia and New Zealand. It will probably become the standard hive for South Africa, where already it outnumbers all other types of movable comb hives. This hive should be fitted with

telescope cover with metal top, wooden inner cover, and with full sheets of comb foundation wired in the frames. There should be two 10-frame brood chambers and a supply of supers adequate to care for the maximum honey-flow. Deep or shallow supers are preferable according to circumstances. Beginners who do not wish to go to the expense of a honey extractor should get shallow extracting supers.

Necessary Equipment.—A good beginning in modern bee-keeping can be made with the following equipment:—

A modern hive consisting of a bottom board, two 10-frame Langstroth brood chambers, three shallow extracting supers, one inner cover and one outer cover with metal top. All the frames should be fitted with full sheets of comb foundation with the wire properly embedded in the foundation.

One large bee smoker, the larger the better. One bee veil, one hive tool, and a good handbook on beekeeping.

The Departmental Apiary, Pretoria.

Bees can usually be obtained from disinterested boxhive beekeepers in the neighbourhood, or so-called „ wild swarms " can be hived from the veld. There are no beekeepers in South Africa who make a business of selling bees.

Beehives and parts, comb-foundation, bee-veils, smokers, beekeepers' gloves, and embedders are now admitted free of customs duty. An introduction permit from the Division of Entomology is required for comb-foundation. The importation of bees and second-hand equipment is prohibited.

Transferring Bees to Modern Hives.

1. Smoke the bees a little, then remove the box-hive out of the line of flight of the bees, and substitute the new hive containing frames with full sheets of comb-foundation. As the field bees return they go at once to the new hive.

2. Turn the box upside down, remove the bottom, and invert an empty box over the opening. Pound the box-hive vigorously for several

minutes until the bees desert their combs and enter the box above. The bees cluster in this box like a natural swarm, and may now be shaken into or in front of the new hive as in hiving a swarm clustered on a tree.

In shaking the bees in front of the hive, place a wide board sloping from the ground up to the entrance and toss some of the bees in the entrance as well as on the board. A piece of newspaper or a cloth may be spread over this board to increase the surface up which the bees must crawl to the entrance. Spreading the clusters in this way facilitates the finding of the queen and her entrance can be noted.

3. The best combs of brood in the box may now be tied into frames and placed in the new hive; the remaining combs can be disposed of as desired.

Bees will rarely abscond if unsealed brood is present in the hive. As a precaution, should no brood be available, the queen-exluder zinc may be placed between the bottom board and the brood chamber, or a piece of this zinc may be nailed over the entrance, thus confining the queen to the hive. This excluder must be removed after the colony has established itself on the frames containing the comb-foundation. Feed the transferred colony with sugar syrup, liberally, this will prevent it from absconding.

The honey from the box hive may be mixed with an equal volume of water, strained through a cheese-cloth, and fed to the bees as described in books on beekeeping. If there is a dearth of nectar and no feed is given, the bees will gnaw holes in the comb-foundation, which they may subsequently fill up with undesirable drome comb.

Pests and Diseases.

Ants.—In some localities ants trouble the bees to such an extent that they cause swarms, especially newly hived ones, to abscond. Wagon grease, motor oil, or corrosive sublimate can be used to isolate the hives against ants.

Disease.—European foul brood is the only serious brood disease that the South African beekeeper has to contend with, and it is very easily controlled. Preventive measures are: (1) Ample protection, (2) requeening frequently, (3) leaving plenty of stores for the winter or any period of dearth. In brief, the treatment is to bring about conditions which keep the colony strong at all times.

American foul brood and Isle of Wight disease, two serious diseases in other countries, have never been found in South Africa.

Cardinal Points.

1. The successful beekeeper is he who studies his bees and is prompt with his manipulations. Bees to be profitable must receive intelligent care.

2. Bees need plenty of stores, plenty of room for brood, rearing, and adequate protection from wind and cold.

3. Practise swarm-control measures. Swarming during the honey-flow reduces the crop.

4. During the honey-flow give plenty of storage room, adding supers in advance of requirements. Neglect of this may lose more than half the crop.

A more effective bait is made up as follows: Take 2 gallons of soft water in a four-gallon drum and in this dissolve 6½ oz. of sodium fluoride. With a sharp knife chop up prickly-pear leaves into small pieces the

5. It does not pay to cultivate any plant for bees. It may be possible in certain localities to improve the nectar resources by planting nectar-producing plants on waste land.

 [Continued on page 758.

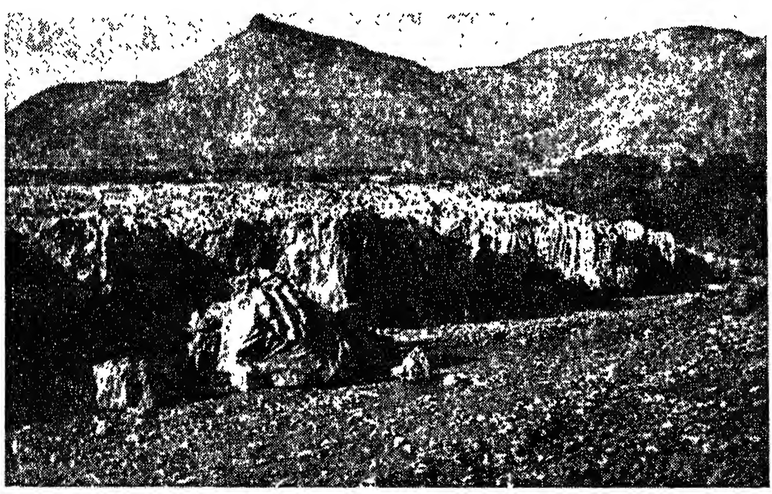
Soil Stability and Veld Management.

J. P. Botha, Agricultural Research Institute, Pretoria.

THE reason for the necessity to-day of spending thousands of pounds in restoring damage from soil erosion, must be sought in the maladjustment of farming practice to conditions peculiar to the regions concerned. In the Drakensberg and Vlekpoort Conservation Areas, we have striking examples of what happens when soil utilization and soil stability do not go hand in hand.

In the past too much attention was devoted purely to production and too little to systems of soil utilization conducive to the maintenance of the soil—the basis of production. A serious decline in production over vast areas, was the inevitable outcome and it ultimately became necessary to spend thousands of pounds on preventing certain areas from becoming completely lost to farming.

The conditions which led to the introduction of the drastic measures at Vlekpoort and other conservation areas, have by no means disappeared from other parts of the country, and the danger exists that, while on the



A striking example of serious soil erosion. Vlekpoort Conservation Area.

one hand the consequences of old malpractices must be offset at tremendous cost, the same causes may lead to similar conditions in other areas.

In the final instance soil conservation rests with the individual farmer himself. He must not lose sight of the fact that the extreme conditions existing in conservation areas arose from small beginnings on individual farms. If farmers had been alive to the danger then, they could have obviated the tremendous loss of soil and grazing simply by applying correct methods of soil utilization. Production alone is not the most important function of the farmer. Permanent production and soil stability are indissoluble. The ideal, therefore, is to obtain the maximum production concomitant with soil stability. There cannot be any justification for production at the expense of soil stability.

Damage to Pastures.

When speaking of production and soil stability one is all too apt to think of ploughed land under crops. The conservation and correct utilization of such soil is, of course, of the utmost importance, and it is essential that the maximum production be obtained without loss of soil. It is noteworthy, however, that the biggest soil losses in South Africa cannot be ascribed to the plough, and have not occurred on cultivated land, but are the result of incorrect utilization of the *natural pastures.*

If it is realized that more than 80 per cent. of the surface of the Union consists of grazing, it becomes clear why stability of the natural pasturages is of such vital importance. In the past the tendency has been to regard the natural pasture as a kind of gift—a gift requiring no special attention, but which will year in and year out give yields irrespective of the treatment it receives. The fact that the veld consists of living plants subject to certain natural laws is usually ignored.

It was never realized that the complex composition of the veld was influenced to no small extent by the treatment it received as, for example, grazing at different times of the year, veld burning, etc., and that the capacity for production and the stability of the veld are intimately connected with the methods of its utilization.

Much of the damage to production and soil is ascribable to this general negative attitude to the natural veld.

Soil and veld conservation do not necessarily imply the extensive use of machinery for the construction of dams, filling of gullies and making of contour banks. These measures become necessary only when the damage has assumed serious proportions, and even these measures cannot be of permanent value if the root cause, namely, incorrect veld utilization is not removed at the same time.

Many farmers are inclined to attach more value to the more impressive mechanical activities, such as the making of dams and throwing up of banks, and devote too little attention to the less impressive, though far more valuable, methods of veld management.

Not only will correct methods of veld management prevent the soil from being washed away, but they will also contribute in no small measure to restoring damage already done, and may, in many cases, eliminate the use of expensive machinery altogether.

It is, however, necessary for the farmer to appreciate fully the value of this natural veld. He must realize that veld is a great asset, and that its production value is profoundly influenced by the method of utilization. He must realize that correct methods of veld control not only bring in their train abstract compensation through the knowledge that he is contributing to the ultimate permanence of Agriculture, but that he will also be able to assess his compensation in hard cash or a tidier bank balance.

Systems of Correct Veld Utilization.

The research service of the Department of Agriculture has convincingly proved by practical experiments conducted at various places in the country, that correct veld control repays the effort and has contributed much to establishing the principles to be followed by farmers in the different regions.

The particulars to be followed vary considerably for the different regions, but, on broad lines, farmers, in formulating their system of veld control, should pay special attention *inter alia,* to the following factors:—

(1) *The Type of Stock Farmed.*—Different farm animals have different effects on the veld. It is well-known that, under certain circumstances, maintaining sheep alone will result in deterioration of the veld and ultimately in a serious decrease in production. Experiments have proved that rapid veld deterioration is prevented or delayed by utilizing cattle and sheep together in these regions.

It is important, therefore, to have a suitable ratio of cattle to sheep.

(2) *Resting Period.*—There is perhaps no other single factor which influences the production capacity of the veld to the same extent as the resting period. Since the veld consists of living plants, it should be self-evident that continuous utilization of the veld must ultimately damage it permanently.

In certain parts of the country the veld has an amazing resistance capacity, and its continuous utilization for a number of years without apparent degeneration, often creates the impression among farmers that continuous utilization does not adversely affect the veld.

Such veld, however, deteriorates systematically, and its carrying capacity diminishes imperceptibly until the breaking point is reached, when a large proportion of the grass is superseded by weeds or bare patches, followed by a serious diminution in production, and surface erosion.

Veld which enjoys a proper resting period, is able to resist periods of drought without serious damage, and is often still able to produce when veld continuously utilized, has been destroyed.

(3) *Method of Utilization.*—Increase in live-weight of farm animals is intimately connected with the method of veld utilization followed, i.e. the method of grazing. At the Athole Research Station, near Ermelo, the increase in live-weight over a period of eleven years varied from an average of 149·9 lb. to an average of 272 lb. per morgen, depending upon the method of veld control adopted. The size of the veld and the number of cattle were the same in each case.

(4) *Time of Burning.*—Wrong methods of burning are very injurious and may contribute in a large measure to reducing the carrying capacity and destroying the veld. In certain regions burning, as a farming practice, should be unconditionally condemned, while in others, burning is essential to adequate veld control.

Where burning must be resorted to, there are certain factors to be considered for the resultant damage to be reduced to a minimum. Such factors as time and frequency of burning are of extreme importance.

(5) *Camp Systems.*—Farmers subdividing their veld into camps, must do so, in the first instance, with a view to a system of sound veld utilization. Veld may be used to its utmost capacity if a proper system of paddocking exists. In many cases a good grazing system may be followed on the camps already in existence on the farm. Farmers should not abandon the application of sound principles of veld control simply because wire is in short supply to-day, or because it is too expensive for making the camps necessary to conform to a well-planned grazing system. Nor need they necessarily start off with a wholly balanced system.

A few fundamental principles of veld control may be successfully applied even if all the necessary camps are not yet available.

A resting period, for example, may be instituted, or burning may be carried out at the correct time. The correct application of only one of the basic factors will contribute much towards stabilization of soil under natural veld.

On certain farms the veld has already deteriorated to such an extent that the introduction of a good control system alone can no longer save the situation and the only remedy is to establish the original grasses by sowing seed.

This condition may be entirely avoided by controlling the veld early and correctly.

Sound veld management is in the interests of every farmer and each individual will find that, by looking to his own interests and utilizing his veld judiciously, he is at the same time making a contribution towards a tremendous increase in the country's livestock production.

The Production of Nicotine Sulphate from waste Tobacco:—

[*Continued from page* 736.

The organic solvents, such as ether, petroleum ether and paraffin failed to give satisfactory results in the extraction of nicotine from alkali-moistened tobacco or alkali-hydro extracts. Trichloro-ethylene extracts all the nicotine from alkali-moistened tobacco, but after repeated heating it becomes very diffcult to leach the nicotine from trichloro-ethylene by means of diluted sulphuric acid. A possible reason for this is given.

Nicotine is very easily leached from tobacco by means of water in a continuous successive leaching process, or by pressure. In large-scale experiments the leaching process is more economical than pressure. Using tobacco and water, in the ratio of 1 to 4, 99 per cent. effciency is obtained in large-scale experiments with five successive leachings.

By means of unheated steam or direct distillation the nicotine is distilled from the alkali extracts, recovered in diluted sulphuric acid and fixed as nicotine sulphate.

In an experimental installation, where the sulphuric acid receptacles were kept at a temperature ranging from 125° C. to 130° C., a total efficiency of 95 per cent. was obtained.

Ammonium sulphate, which is used as fertilizer, is obtained as a by-product. The leached tobacco residue could be used as fuel and the nicotine-free tobacco extract residue as fertilizer.

The various co-operative tobacco societies are best able to produce nicotine sulphate from South African waste tobacco. Ruling tobacco prices are however, so high that nicotine sulphate could not economically be produced from the poorest types of tobacco.

(Dr. C. P. Naudé, Division of Chemical Services, Pretoria).

The Fight Against Insect Pests.

Dr. Bernard Smit, Division of Entomology, Pretoria.

THE losses caused by insect pests to our food supplies are much greater than most people realize, and it is therefore of the utmost importance at a time like this that we push ahead with our entomological research work and with our pest control measures.

In a bulletin on the maize stalk borer, the authors, du Plessis and Lea, estimate that this insect alone causes an annual loss of one and a half million pounds worth of mealies in South Africa. After the mealies are harvested and stored, they are subject to further attack by weevils and grain beetles, and may, in a few months, be completely destroyed if adequate precautions are not taken.

All stored grain is subject to the attack of weevils, particularly if it has not been thoroughly dried before storage, and a constant watch should therefore be kept for these destructive pests. Some time ago, in Johannesburg, a large consignment of rice was found to be infested with the rice weevil and would have been destroyed within three or four months if the rice had not been promptly fumigated and cleaned. After the treatment, the clean white rice was estimated to be worth at least fifteen thousand pounds.

Careful Research Work.

On the mines, enormous quantities of cowpeas are used for feeding the mine natives in the compounds, because these small beans have a very high nutritive value and are very palatable. They are, however, very subject to the attack of the cowpea weevil, which starts its attack in the field before the cowpeas are reaped and continues to destroy them in storage. It is only by careful research work that such problems can be solved, and, in this case, by installing suitable cleansing facilities, and by proper fumigation the cowpeas have been kept in good condition and fit for human consumption.

The development of industry in South Africa, particularly in connection with foodstuffs, has greatly increased our insect problems. When we first started to make army biscuits on a vast scale and they had to be packed for long storage in tropical regions, the danger of weevil attack was at once realized and suitable precautions had to be devised. The same has applied to the parcels containing dried fruit and biscuits which were sent to our prisoners-of-war in various parts of the world.

And now let us turn to the production side. During the war it became very difficult to obtain the poisons that we use for controlling insect pests in our lands and gardens and so we had to turn to other methods. One very promising method is biological control. This involves the use of parasites to prey on the pests—mainly insect parasites which must be reared in special insectaries and liberated in infested fields. This work requires exceptional facilities and must be carried out by specially trained entomologists. We are pushing ahead with it as fast as possible. The main pests we hope to control in this way are codling moth in apples, the Karoo Caterpillar, caterpillars on cabbages, and the brown-tail moth in pine plantations.

Cultural Practices.

Another practical method concerns proper cultural practices and crop rotation. In the first place, we find that where crops are grown in soil that is well cared for and well manured, they are not so susceptible

to the attack of pests as those grown in poor soil and neglected. An example of this was observed on a farm which was altogether in a neglected condition, and there a land of cabbages was being entirely destroyed by Bagrada bug, while only a few miles away on a farm that was being well looked after a magnificent stand of cabbages of the same variety was hardly infested.

In the case of soil infested with eelworm, for instance, farmers should incorporate large quantities of humus, manure and other plant food into the soil to maintain its fertility. The object is to force the crop to grow ahead of the eelworm attack on the roots.

Rotation of crops is very important and for each land on the farm a proper sequence of crops should be worked out according to the main crop to be produced. This practice is based on the fact that certain pests are more or less specific and will only attack certain kinds of plants. For instance, winter cereals, such as wheat, oats and rye are resistant to the attack of eelworm, as also are the summer cereals, maize, teff and kaffircorn, and the summer legumes sunnhemp and groundnuts. On the other hand, tobacco, potatoes and tomatoes are very susceptible to eelworm attack. If we have an infested land, we can starve out the eelworm by growing, say, winter cereals and sunnhemp for three years, after which the land should be sufficiently free of the pest to grow a clean crop of tobacco or possibly potatoes. The sunnhemp can either be ploughed in for green manuring or it may be cut for fodder.

Control of Weeds.

It must be remembered that many pests, such as cutworms, armyworms, plant bugs, etc., live on weeds as well as on our crops and the destruction of weeds is a very important control measure. This means winter ploughing and regular shallow cultivation. By turning over the soil, many pests, such as white grubs, are brought to the surface and destroyed either by birds or by frost. Pupae in the soil, such as those of cutworms and armyworms, are destroyed mechanically and eelworms in loose soil near the surface die from desiccation. The eggs of the Bagrada bug are laid under clods of earth and the turning over of these clods and exposing the eggs to direct sunlight, prevents them from hatching. In order to make this regular cultivation possible, crops like mealies, kaffircorn and vegetables, like cabbages, should be grown in rows.

All this comes under the heading of what we call "clean culture". An important part of clean culture is the adequate disposal of all discarded and useless parts of a crop after it has been reaped. For example, when cabbages have been cut, the old stumps should be pulled up and disposed of in the compost heap, otherwise they will continue to grow and throw out shoots, which provide ideal winter quarters for the cabbage aphid. Likewise, in the case of the maize stalk borer, the old maize stubbles form the winter quarters of these caterpillars or borers which emerge as moths, from these old stalks in the spring to start the infestation of the following summer. The grubbing out and burning of the old stalks during the winter is one good method of controlling the maize stalk borer.

All sorts of mechanical methods are used against insect pests as opportunity offers, and farmers must always be on the lookout for an opportunity and must constantly use their imagination and ingenuity. By applying practical measures with the means already at our disposal, we can often save valuable insecticides and control the pests effectively. In this way we save enormous quantities of food stuffs, which are so urgently needed in the world at present.

The Walking Habits of Sheep.

D. J. Louw, C. M. Havenga and J. Hamersma, Grootfontein College of Agriculture, Middelburg, Cape.

UP to the present research work to determine the walking habits of sheep under natural conditions has not been undertaken. If one considers the immense importance of walking in the adaptability of sheep to different environments, the necessity for research work in this direction becomes evident. The animal which is able to cover vast distances in the minimum time, will be able to go out in search of food in the more arid regions of the country. Here, however, we are faced with the problem as to whether increased tendency to walk much, beneficial as it is in their search for food, is not injurious to the veld because of the trampling involved. Then again, some breeds may habitually cover great distances despite a plentiful supply of easily accessible feed.

The Black-head Persian and Karakul ewes used in this experiment.

A preliminary experiment was carried out in order to throw more light on this point. There are, however, numerous factors which may play a part, e.g. the season of the year, the amount of available feed in the camp and the size of the flock. It was, of course, impossible to investigate all these factors in the preliminary experiment. The experiment was, therefore, conducted as follows:—

(1) Twenty full-grown ewes were taken from each of the following breeds: Black-head Persian, Merino, Karakul and Dorset × Persian semi-hybrid.

(2) The experimental camp was 147 morgen in extent, viz., 1,000 yds. by 1,500 yds., more or less rectangular, and water was provided in one corner. The camp was situated to the south

of a ridge and although not altogether level, the entire area is easily accessible to sheep.

(3) The experiment was first commenced in the winter of 1947.

The camp was divided into squares of 300 yds. by 300 yds. and a flag planted at each point of intersection, to enable the position of the sheep to be determined at some distance, by means of binoculars. The position and distribution of the sheep were then plotted on a map drawn to scale. Hourly observations were made.

All four groups were placed in the camp for three days. It was clear from the start that, although the d.fferent breeds separated, they did follow one another to a certain extent and went to drink water at the same time.

The following figures show the distances (in yds.) covered by the sheep per day.

	Black-head Persian.	Dorset × Persian.	Karakul.	Merino.
	Yards.	Yards.	Yards.	Yards.
1st day together	5,229	6,738	4,868	4,836
2nd day together	4,580	4,053	3,764	2,795
3rd day together	6,405	4,845	5,075	5,945
Average	5,405	5,212	4,569	4,525

Owing to the large variation and the small number of repetitions, these distances do not differ statistically.

In order to eliminate the difficulty of the breeds following one another, it was decided to watch each group separately in the camp for two consecutive days. Lots were cast to decide the order in which the groups were to be placed in the camp. The following results were obtained:—

	Black-head Persian.	Dorset × Persian.	Karakul.	Merino.
	Yards.	Yards.	Yards.	Yards.
1st day separately	4,555	5,505	3,325	4,515
2nd day separately	6,240	5,645	4,260	3,350
Average	5,397	5,575	3,792	3,932

The figures show that the Black-head Persians and the Dorset × Persians covered approximately the same average distances, while the Karakuls and Merinos covered considerably less.

Although the observations of the separate groups were made over a short period when weather conditions were comparatively uniform, one should not lose sight of the fact that the different days might have had some influence on the results.

During February, 1948 the experiment was repeated, to compare the results of the previous winter with those of a summer season.

In order to eliminate the two chief obstacles in the previous experiment, viz., (1) the fact that the different groups followed one another in the same camp, and, (2) the influence of weather conditions, it was decided to use two adjoining camps. The second camp was 135 morgen in extent (900 yds. by 1,500 yds.) and more or less rectangular. The same procedure of dividing into squares and planting flags was followed here. Both camps contained plenty of feed for the sheep.

Since only two of the breeds could be observed simultaneously and since the previous results suggested that the Merinos and Karakuls walk less than the other two breeds, it was decided (1) to compare these two breeds, (2) then to compare the Black-head Persians with the Dorset × Persians, and (3) subsequently to compare one of the first two groups with one from the second groups.

Lots were cast to decide which breed should go into the first and second camps. The sheep were kept in the camps for 3 days and observations were made on the second and third days only, to give the sheep a chance of becoming accustomed to the camps during the first day. The sheep were then changed about and observations were again made on the second and third days.

The following results were obtained:—

	TEST 1.		TEST 2.		TEST 3.	
	Merino.	Karakul.	Dorset × Persian.	Black-head Persian.	Black-head Persian.	Karakul.
	Yards.	Yards.	Yards.	Yards.	Yards.	Yards.
1st camp.......	7,285	6,380	9,685	8,660	7,995	6,035
	6,160	7,410	10,575	8,275	8,970	6,860
2nd camp......	4,560	5,110	7,780	7,430	7,125	4,290
	4,680	4,575	4,575	9,385	7,055	5,685
Average......	5,671	5,869	8,889	8,438	7,786	5,713

Conclusions.

(1) The Black-head Persians and the Dorset × Persians walked more than the Merinos or the Karakuls.

(2) The Black-head Persians did not walk significantly more than the Dorset × Persians, i.e. they could be placed in the same groups as far as walking habits are concerned. The same applies to the Merinos and Karakuls.

(3) The sheep all walked more in the first than in the second camp, probably because this camp is more square and the furthest points are considerably nearer the water than in the case of the first camp.

(4) The sheep walked more in summer than in winter, probably on account of the longer days.

(5) Except for the Merinos, which skipped a day, the sheep drank water once a day. The drinking times occurred between 9 a.m. and 6 p.m.

Nutrition of Poultry.

Bulletin No. 260, "Nutrition of Poultry" by Prof. A. M. Gericke, which was out of print for a time, has been reprinted, and is again available.

It is obtainable from the Editor of Publications, Pretoria, at 6d. per copy, post free.

Cutworms in Farm Lands and Gardens.

Dr. Bernard Smit, Principal Entomologist, Division of Entomology.

ONE of the worst and most persistent insect pests in farm lands and gardens in South Africa is the cutworm of which there are several species. In many parts of the country the attack on young maize plants, beans, etc., is so severe that lands often have to be replanted two or three times. In other cases, where weather conditions do not permit of such replanting, crops are sometimes totally destroyed.

In gardens a great variety of plants are attacked, particularly cabbages, cauliflowers, tomatoes, lettuce and beans in the vegetable garden, and dahlias, petunias, stocks, asters and many others in the flower garden.

Most of this damage occurs in spring, and usually by the time the farmer or gardener has noticed it, the opportunity of controlling the pest has passed. In such cases the advice of the Entomologist should be filed and kept for reference next season.

Life-cycle and Feeding Habits of Cutworms.

During the winter the insect is present in the soil as a full-grown caterpillar, either unprotected or in its earthen cell. As the spring approaches, the caterpillars pupate and when the weather begins to get warmer in September, the adult moths emerge to fly about at night and lay their eggs. They are called *Noctuidae* or night moths, because of their habit of flying at night. The moths measure about 1¼ inches across the open wings, and are dull buff or brown in colour, with the forewings much darker than the hindwings. The female moth lays her eggs in great numbers on the leaves of weeds, which are the foodplants of the caterpillars. A single moth may lay over a thousand eggs. These eggs hatch in about a week and the tiny black caterpillars which then emerge feed on the leaves of the weeds for a few days, but soon develop their characteristic habit of lying hidden in the ground during the day and coming out to feed at night.

At this stage, the caterpillar is of a dirty greyish colour and naked—that is, without hairs—and when found in the soil always curls itself up into a little ring. The surface of its body has a smooth waxy appearance. It is often rather difficult to find cutworms in the soil, unless they are very abundant or the soil is carefully dug over and sifted.

At night, when the caterpillars crawl about on the surface of the soil, they have a characteristic method of feeding, from which they have derived their name. They bite off young plants just above the surface of the soil, leaving the top portion lying as if it had been cut off with a blunt knife. The worm eats very little from each plant, but the plants are destroyed and it crawls from one to another, sometimes cutting off a large number in a single night. A single cutworm caterpillar can therefore do a considerable amount of damage, and where a land is fairly heavily infested, it is not surprising that the whole crop is soon wiped out.

It should be remembered that cutworms can live for some time in the soil of a cultivated land without food or by feeding, to some extent, on weeds that have been "ploughed in". What very often happens in practice is that there is a good growth of weeds in a land after the early spring rains. and the first generation of caterpillars begins to develop

on these weeds. The farmer then ploughs and prepares his land for planting, and in this process the small cutworms are buried, but by no means destroyed. When the crop is up, as in the case of mealies, or planted out, as in the case of vegetables, the cutworms come out of the soil in search of food and "reap" the crop.

Control Measures.

There are three main methods of control for cutworms which have proved very satisfactory:—

(1) The destruction of the full-grown larvae or pupae in the soil during winter by means of winter-ploughing. This is undoubtedly the best and most practical control method in many parts of the country. The ploughing should be done at least six weeks before planting. The larvae and pupae are crushed or brought to the surface, when they may be killed by frost or eaten by birds. On many farms in South Africa, winterploughing definitely prevents cutworm damage to mealie lands.

(2) By the starvation method, which consists in keeping weeds down in spring by ploughing and systematic cultivation. The ploughing should be done about 45 days before the land is planted, or, in the case of maize, 35 days before sowing. This allows 10 days for germination of the maize. After ploughing, the land should be kept free from weeds by cultivation, until the crop is put in. In this way a good seedbed will be prepared, and there will be no weeds on which the moths, which fly over from neighbouring lands, can lay their eggs.

(3) Where the above methods are not practicable, and there are cutworms in the land, a poison bait can be used, preferably after preparation of the seedbed but before the crop is planted. The cultivation removes the natural food of the worms and drives them to the bait. The bait should be scattered in the late afternoon, so that it will remain moist as long as possible and be ready for the cutworms when they come out to feed at night. In heavily infested lands, several baitings may be necessary. The bait is usually broadcast at the rate of about 100 lb. per morgen, but a great deal depends on the nature of the soil and the degree of infestation. Sometimes, after the first planting of maize has been eaten off by the worms, it is possible to kill them with bait before the next lot of seed is put in, but this is rather like locking the stable door after the calf has run out.

Different Baits.

There are several different baits that can be used, but, on the whole, they may be classed either as green baits or as bran baits. The green baits are usually more attractive than the bran mixtures.

Arsenical poisons are used, such as Paris green, arsenite of soda (locust poison), calcium arsenate and arsenate of lead; or the non-arsenical sodium fluoride may be used. This has the great advantage of being less dangerous than the arsenical poisons. For green bait, use finely chopped up green stuff, such as green barley, beetroot tops, potato tops, young maize, etc., or cut up pricklypear pads. Lucerne is not usually attractive. The chopped-up green stuff is then moistened with a sweet poison solution or suspension made up as follows:—

Dissolve or mix 1 lb. arsenite of soda or 1 lb. Paris green or 1½ lb. calcium arsenate, or 1½ lb. arsenate of lead powder in 8 gallons of water, and to this add 8 lb. of sugar or 1 gallon of molasses.

The green stuff should be moistened with this to make a damp mash. which will scatter well and not lie in lumps on the ground. Be careful to stir the poison mixture continuously while adding it to the green stuff and then mix the whole mass thoroughly together.

size of one's thumb, and add a volume of two gallons of these to the sodium-fluoride solution in the drum. Stir and allow to soak overnight. After twelve hours, drain through a sack or wire gauze and use as soon as possible. The solution should not be used more than once. *This bait is not dangerous to stock, but is more effective against cutworms than the baits containing arsenic because it is more attractive to them.*

A very convenient bran bait which has been largely used all over the world, can be made up from 1 lb. arsenite of soda or 1 lb. Paris green or 1½ lb. calcium arsenate, or 1½ lb. arsenate of lead powder, 4 lb. sugar or ½ gallon molasses, and 20 lb. bran.

Mix the dry poison very thoroughly with the bran, so that every particle of bran carries a little poison to give a good kill; then mix the syrup or dissolve the sugar in one gallon of water, and slowly add and stir this into the poisoned bran. The bait should form a crumbly mash, which will not form lumps on the ground that may be picked up by domestic animals. In order to avoid getting the mash too wet, keep aside a little of the bran mixture while mixing in the water, so that, if too much water has been used, this dry reserve can be added to bring the bait up to the proper consistency.

If ansenite of soda is used as the poison, special care should be taken not to throw the bait on to or against growing plants, since the poison is very caustic and may burn them. In gardens it is advisable to scatter the bait carefully around the plants with a large spoon. In farm lands, it must be broadcast.

As stated above, the best results are obtained in fallow lands, which have been cleared of all vegetation and where the cutworms are very short of food.

Information on Beekeeping:—

[*Continued from page* 746

6. Do not let bees starve or even get so short of stores that they decrease brood-rearing before the honey-flow. A large force of bees at the right time must be the aim of every beekeeper. If it becomes necessary to feed, give a syrup consisting of two parts by volume of granulated sugar to one part of water. In warm weather one part of sugar to one of water is preferable. Each established colony should have 40 to 50 lb. of honey for its own requirements.

Beekeepers' Associations.—The South African Association of Beekeepers, P.O. Box 9378, Johannesburg.

The Natal and Zululand Beekeepers Association, 29 Strott Road, Pietermaritzburg.

Western Province Beekeepers' Association, P.O. Box 3306, Cape Town.

Transvaal Beekeepers' Association, 1112 Terblanche Street, Villieria, Pretoria.

O.F.S. Beekeepers' Association, P.O. Box 619, Bloemfontein.

Instruction in Apiculture.—Short courses of instruction in apiculture are given at the Agricultural Colleges and at the Departmental Apiary, Pretoria. Further particulars are obtainable from this office.

(Division of Entomology, Pretoria.)

How to Make Good Veld Hay.

J. P. Botha, Pasture Research Officer, Athole Experiment Station.

DESPITE the fact that the natural grazing of the Union regularly yields large quatities of surplus plant material, it happens every year that stock die in thousands of direct or indirect starvation . If utilized in the form of hay, this surplus grass could considerably reduce these unnecessarily high losses and would enable thousands of farm animals which are with great difficulty merely kept alive during winter, to survive that season in good condition.

Hay Instead of Winter Grazing.

Veld hay can be made in any part of the Union where the natural grassveld can be mowed and the grass is suitable. In the sour and mixed grassveld areas, hay-making is of much greater importance than in the

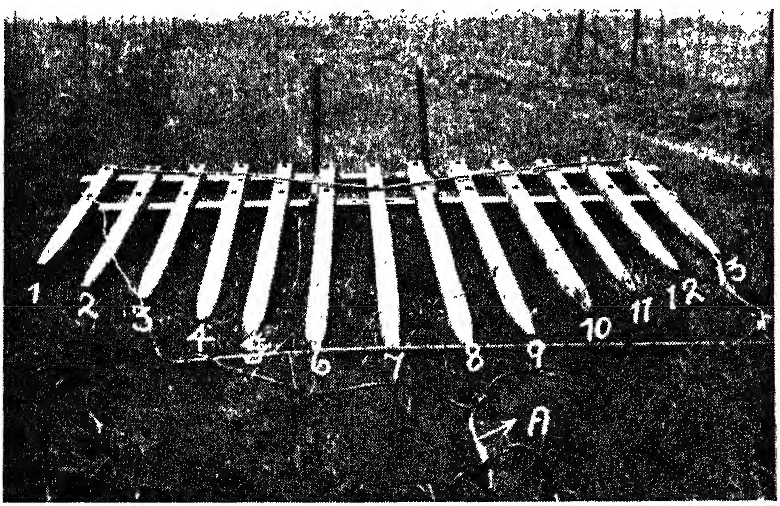


FIG. 1.—Hay-sweep for collecting veld hay.

bushveld and other sweet grassveld areas. Sour grass loses its palatability and to a large extent also its nutritive value as soon as it reaches maturity. Consequently, sour veld is of little value during the winter months, unless the grass is cut in summer and preserved in the form of hay. To a lesser degree, this also applies to mixed grassveld. In the latter case, animals can admittedly exist on the winter veld, but as a rule, are then in such poor condition in spring, that it would have been much better to use the veld for hay than for winter grazing.

In the sweetveld areas the loss of palatability and nutritive value is much smaller than in the case of sour veld; consequently the veld can be kept in reserve during summer and grazed during winter with good results. In these cases the making of veld hay is not so important. As a rule, however, the sweetveld areas are much more subject to drought, since,

the rainfall being irregular, periods of abundance are only too often followed by times of serious scarcity. The surplus grass can be preserved in the form of hay without much trouble, and in this way valuable feed reserves can be built up for periods of drought out of material most of which would otherwise be wasted.

There are no grounds for the prejudice against veld hay so often displayed by farmers. The contention that the low yields of hay are not profitable, is based on an imperfect realization of the principles of veld control. Veld which has been cut, not only yields the hay thus obtained, but gives more and better grazing during the following season.

The Correct Stage for Cutting.

The younger the grass, the higher its protein and phosphorus content, and the more digestible the cellulose. As the grass becomes older, there is a gradual loss in respect of the first-mentioned two constituents, while the cellulose becomes less digestible. In other words, the younger the

FIG. 2.—Veld hay under cover at the Athole Research Station.

grass, the higher its nutritive value and the better will be the hay made from it. On the other hand, it is also true that the younger the grass, the smaller the yield of hay and, as a result, the higher the cost of making it. It is, therefore, best to cut the grass at a stage when the yields will not be too low and the nutritive value will still be adequate.

As a general rule the early flowering stage has been found to be the correct time for cutting. Grass which has almost reached the mature stage is not suitable for good hay, although it can sometimes be used as a stand-by and is in any case better than nothing at all.

Treatment of the Grass.

There are various methods of treating the grass, of which the following will be found the easiest and cheapest. The grass should be cut on a sunny day and left on the veld until it begins to dry. Rainy days and misty

weather are not suitable. When the grass is no longer damp to the touch, yet is not sufficiently dry to break when a handful is twisted, it can be raked together in stooks. On a warm day, exposure to the sun for 2 to 3 hours is usually adequate. It is essential not to allow the grass to become too dry before raking it together, since a certain degree of moisture is needed for proper curing of the hay. Hay does not merely consist of well-dried grass, which lacks the characteristic smell, colour and palatability of good hay. In addition, hay which has been exposed to the sun for too long a period will lose a large percentage of its carotine content. Grass which is too damp, however, generates too great a heat in the stack as a result of which the hay becomes mouldy and unpalatable.

In the case of very short grass, the common hayrake is not always very effective since the short grass slips through the prongs. This difficulty can be overcome by fixing strips of smooth calvanized iron,

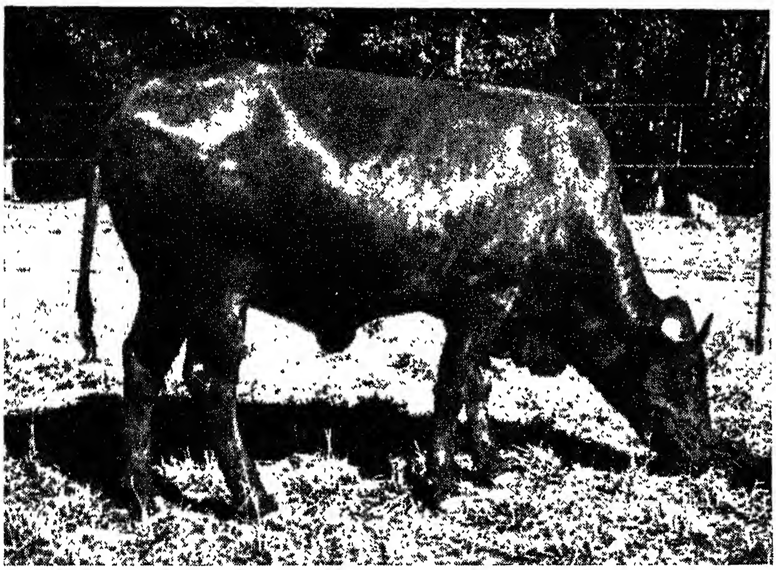


FIG. 3.—An Africander heifer after a winter on veld hay.

approximately 2½ inches broad, to the prongs in such a way that the open spaces between the prongs are reduced to about ½ inch each. In the case of veld hay it is unnecessary to make drying cocks, but the grass may be raked together with a hay sweep (Fig. 1) immediately after completion of the stooks and carted away. The hay must be stacked immediately. It is essential that all the hay cut during the day should be stacked before the same evening. It has been found that wide stackes are liable to generate too much heat as a result of which the hay becomes mouldy. A width of approximately 12 feet is most satisfactory.

A simple curing shed for the treatment of hay has been designed at the Estcourt Pasture Research Station. Immediately after being cut, the grass is raked together and transported to the shed where it is stacked in such a way that a free passage is left for air from the centre of the stack to the top, and at intervals of 3 feet from the bottom upwards, air passages of wire mesh lead to the centre through the stack. This method of ventilation prevents the development of too high a temperature.

 Continued on page 763.

The Utilization of our Lands.

WE are witnessing an era of record prices on every hand. Prices of farming implements are exceedingly high, labour is scarce and expensive and land prices have reached dangerous peaks.

Fortunately, the farmer is able to dispose of his produce at remunerative prices which, under prevailing conditions, still permit of economic production. It is, however, of the utmost importance that the farmer should make the best use of his cultivated lands or he may find that, despite the high prices, he is not farming succesfully.

At present much is being said about soil conservation and it is no more than right that every citizen of our country should be interested in this subject. It should, however, be borne in mind that the term is very comprehensive and that it also includes soil utilization. The farmer should utilize his lands in the best way so as to enable him to apply further conservation measures. Mere soil conservation as such is of minor importance to the farmer; it should be a means of increasing the productivity of the soil for the use and benefit of the farmer and his descendants. In this connection a few factors may be pointed out:—

(1) First, thorough and timely preparation of the soil in accordance with the requirements of the crop to be grown on it, is essential.

The difference between well-prepared and poorly prepared lands may be observed on every hand. Generally speaking, the soil should be ploughed fairly deeply, say from 7 to 9 inches, followed by shallower ploughing and cultivation, as with disc and tined harrows.

Our country is subject to periodic droughts, and lands which are thoroughly cultivated not only have the best chance of success during such times, but also produce greater yields.

(2) The farmer also has to make sure that the crop he intends planting is the one best suited to the climate and soil type and that it will give the best returns. He is often tempted to plant a crop fetching high prices but it may easely be a failure because of unsuitable growth conditions, etc., on his particular farm. He should also try to obtain the best seed.

(3) The impoverishment of our soils by over-cropping is still occurring on far too large a scale. Some of our lands continue to produce good harvests after years of cultivation while others are soon exhausted. It is certain, however, that all lands will gradually become impoverished if no precautions are taken.

As much of the waste material as possible should be returned to the soil, and deficiencies in minerals should be supplemented.

Furthermore, a good crop rotation system should be introduced, in which a perennial and legume crop should be included, if possible, in order to maintain soil fertility.

(4) Weed control is another all-important factor. Farmers lose millions of pounds (calculated in money value) annually through not keeping their lands free of weeds. This enemy deprives crops of water and plant food and is the main cause of reduced yields or even complete failure. Our soils are deficient in plant nutrients and our rainfall is very limited and erratic. Consequently the farmer cannot afford to allow weeds to consume these limited supplies.

It is, therefore, necessary to prepare lands thoroughly and to destroy weeds in spring before crops are planted or sown. In doing this, each farmer should use his common sense as he knows his lands and the position regarding weeds. Some lands may be so seriously overgrown that

it will not be worth while to plant certain summer crops such as maize, kaffir corn, groundnuts, etc., as weeds usually gain the upper hand. A fodder crop, which is cut before the weeds form seeds, should preferably be sown on such lands. The soil can be ploughed later and prepared for winter crops. Crop rotation may play an important part here and the crops should be chosen in such a way as to contribute towards ridding the lands of weeds.

(5) The farmer should also take account of his requirements with regard to stock feed on the farm. Part of the land should be used for the production of fodder crops, i.e. hay silage and green pasturage. A leguminous crop, which will provide the animals with the necessary proteins, should definitely be included as legumes also contribute towards improving soil fertility.

There are suitable legumes and fodder crops for each environment.

(6) The farmer should also pay attention to the general planning of his farm. If possible, crops should be chosen in such a way that all of them do not have to be cultivated and harvested at the same time. Labour should be utilized advantageously throughout the year. When planning crop rotation, this factor should also be borne in mind.

In the utilization of his lands the farmer should, therefore, take all these factors into account. No one can farm on paper but if the farmer devoted some time to careful consideration before starting a new sowing season, it would be time well spent.

Farm planning, not only for the next season, but also for the future, has become an essential in farming.

(J. A. Dreyer, Senior Regional Officer, Bloemfontein).

How to Make Good Veld Hay:—

[*Continued from page* 761.

After having left in the shed for a week, the hay is ready to be removed and stacked. Two great advantages are attached to this method, viz:—

(1) The hay is not exposed to the hot sun; consequently, a greener and more fragrant product is obtained.

(2) The hay is brought under cover immediately, so that in the case of a sudden change in the weather there is less risk of loss.

Farmers are advised to write direct to the Offier in Charge, Pasture Research Station, Estcourt, for a plan of the shed.

The Storage of Veld Hay.

It is essential for stacks of veld hay to be covered as a protection against rain. No matter how well a stack has been built up, veld grass will allow water to penetrate from the top when it rains, with the result that large portions of the stack will become unfit for use.

A simple method of preservation is to build up a stack between poles driven into the ground (Fig. 2) and to place a light movable roof over the top, securing it to the poles. The roof shown in the photograph is made of hessian treated with coal-tar, but owing to the present shortage of this material it will be better to cover the stack with grass.

The Farm Home.

(A section devoted mainly to the interests of Farm Women.)

Modern Cooking-Utensils.

Miss. Jeanne van Schalkwyk, Home Economics Officer of the Department of Agriculture.

ONE of the main features of modern kitchen ware is that it is so practical. It is fashioned to prevent unnecessary loss of heat, to prepare food rapidly and economically with a maximum retention of food value and to entail the least time and energy for keeping it clean. It goes without saying that these advantages are only enjoyed if the equipment is bought, treated and cleaned with care and the directions of the manufacturer are carefully followed.

General Requirements.

There are a few important common points to be taken into consideration, no matter what material is used for a saucepan or pan.

FIG. 1.—Earthen and Porcelainware. Notice glazed finish of baking dish.

The article must be durable. It must keep its shape, wear well must not dent, warp or chip. It must absorb and radiate heat rapidly and evenly. This feature is economical on fuel and not only saves time but improves any cooking method. For the same reasons the bottom of a saucepan or pan should be wide and flat.

The surface of any utensil must be impervious to grease absorption either by giving it a glazed surface, as for instance earthenware, or due to its own qualities. If any grease should be absorbed it would hamper the conduction of heat and cause the utensil to crack.

Naturally any utensil should be such that it can be easily cleaned. For this reason it should have a smooth surface, which does not stain readily, and it should consist of only a few parts, if any.

Operation should be simple and easy. The handles should remain cool, and the inside of the covers should be smooth to prevent food sticking to it.

The finish of any cooking utensil should also be resistant to chemical reactions. This will prevent absorption of odours which are in turn imparted to the food. There was a time when one was never sure whether sudden heat would not shatter a dish, but to-day both glass and earthenware are able to withstand sudden heat and mechanical shocks. This of course does not mean that an article will not break if given a hard knock, but it does eliminate the fear of cracking at the slightest provocation.

The following is a short discussion on the advantages of the various cooking utensils.

Earthenware.

During the war when metal was in demand for other purposes, earthenware became very popular. At present various types of ceramics are obtainable. The first of these is a light porcelain body finished with a glaze. In spite of all its cooking advantages, it is relatively expensive. The second is a semi-porcelain. The main objection against it is the fact that a chip causes it to absorb liquids.

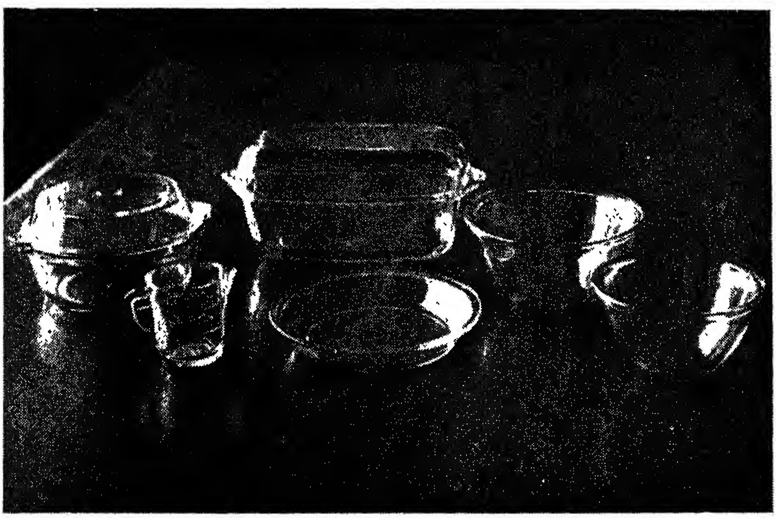


FIG. 2.—Fireproof glassware.

The third type which is of fire clay, is most in demand. It is highly resistant to sudden heat. Unfortunately it must be pressed or cast with great thickness resulting in a heavy article, which, however, does not weigh more than any of the metals used. Food can be served in all these types as they are most attractive. The majority are fashioned for oven use. As only some of them are for use on top of a stove, it is advisable to follow the manufacturer's directions carefully.

Never pour cold water into a hot dish or place hot food in a cold dish. Should food stick or the utensil boil dry, remove it from the heat and let it cool thoroughly before adding water.

Deep fat frying is not recommended and it is advisable to use an asbestos mat for cooking on a stove.

Ceramic ware cleans easily. All that is needed is soap and water. If this is not sufficient, a scouring powder may be used. Avoid damaging the glaze, for then it is difficult to clean the vessel, and besides it will absorb flavours.

Glassware.

Glass ovenware is formed from pressed glass, being thicker and heavier than that used for direct heat or table ware. The latter is blown and for this reason is so thin and fine.

Food cooks quickly in glassware because it absorbs heat rapidly. As opposed to bright metal, glass does not reflect heat, and uses less which makes it more economical. On the other hand it cools down slowly, and therefore keeps the food hot for a much longer time.

There are many other advantages. While the food is cooking, it enables one to see what is going on, and a lot of guess work is excluded. As all these glass dishes are attractive in appearance and food can be prepared, served or stored away in them. This saves a lot of time. The food also remains hot a long time if continued serving is necessary. As these

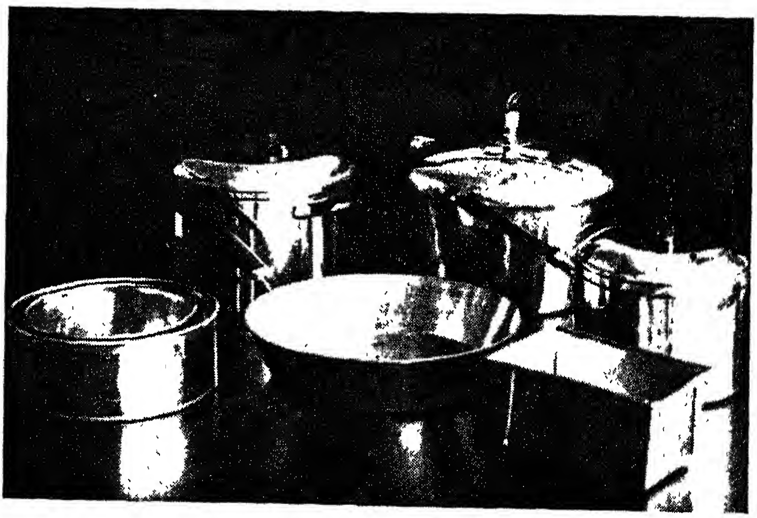


FIG. 3.—Aluminiumware. Saucepans are eamless and bottoms rounded. Notice handles on both sides of large saucepan and heevy bottom of frying pan resting full on heat.

articles do not stain or mark readily, they are very easy to keep clean. Because they can be used for so many different purposes, dish washing is facilitated. Glassware is sanitary, for there are no creases and corners to make washing difficult. It is inexpensive to buy, and with proper care gives long wear. Just observe the following rules:—

Ovenware must not be used on top of the stove. Use a dry cloth for handling, as a damp cloth will cause it to crack. For the same reason a hot dish is not placed on a wet spot, or cold water poured into a hot dish. Ordinarily soap and water and thorough drying are sufficient to clean it. Greasing the utensil will prevent food sticking. Before placing in the oven, wipe off any bits of food adhering on the outside. If the food does burn on, allow the dish to cool, fill it with water and add 3 tablespoons of bicarbonate of soda for every 4 cups

of water. Soak for about half an hour, and then wash in the usual way. To remove any lime deposits making the glass cloudy, soak the dish in a vinegar solution for 10 minutes.

The same care is applied to any utensils for cooking on the stove, but be sure to use a low or moderate temperature and never let it boil dry. When making a gravy, remove the saucepan from the heat and let it cool before adding the liquid.

It is obvious that a hard knock will crack the glass. A crack may not show immediately, but the glass is weakened and it may crack for no apparent reason at some later date.

Utensils obtainable in glassware are coffee and tea pots, saucepans, double boilers, and frying pans. Most of them are fitted with loose handles of metal or plastic material. For ovenware there are various shapes with or without lids.

Aluminium.

Not before 1920 did aluminium come into its own and cease copying other kitchen ware, thus making available various designs. Cast aluminium ware differs from stamped aluminium in that it has no sharp corners, joints or rivets. The latter type may have the handless riveted or welded on in which case it is more expensive. Cast aluminium is more practical for saucepans and fryng pans, while oven ware is made of the other type.

FIG. 4.—Aluminium and Ironware. The handles of the pans are riveted and welded. The bottoms are rounded. The bread pan has a double bottom.

Cooking utensils of aluminium are obtainable in light and heavy weight. The latter is more durable, looks more attractive and distributes the heat more evenly. It is economical on fuel and prevents food from burning. The light type of aluminium is more suitable for cake tins.

Soap and water is all that is necesary to clean them. It is not advisable to use strong alkali soaps, or soda or ammonia, because they discolour and corrode aluminium. If allowed to stand long in water, the finish will become dull. To restore the original colour, cook an acid food in it like tomatoes, or a solution of vinegar or cream of tartar.

There are people who the allergic to aluminium, and this has caused an erroneous belief that cooking in aluminium is detrimental to health, but it may be used with the greatest confidence.

Stainless Steel.

This is a recent innovation for cooking utensils. It is invaluable for institutions, as it seems to last for ever. It is very hygenic—soap and water being sufficient to keep the metal bright. Do not scour with steel wool, because the small particles may stick to the surface and give it a mistaken appearance of rusting. Never allow a stainless steel saucepan to boil dry or subject it to sudden changes of temperature, as this is likely to cause warping.

An intense heat under the utensil is unnecessary, and once the food has reached the desired temperature, the heat should be reduced.

Important Notice

As from January, 1949, the "Farm Home Section" in this journal will be discontinued, and a separate monthly journal "The Woman and Her Home" will be published. The weekly pamflets "Information to Housewives" will also be discontinued as from the end of December, 1948.

In addition to general articles by the Home Economics Officers of the Department of Agriculture, the new journal will also contain the radio talks, at present issued as "Information to Housewives", as well as other matter and useful hints.

The new monthly journal "The Woman and Her Home" will be obtainable from the Government Printer, Bosman Street, Pretoria. The subscription is 5s. per annum, payable in advance.

Subscribe at once to this journal so as to receive it from the first issue. This will enable you to build up your own library on home economics subjects.

New Bulletins.

Bulletin No. 284.—*The Feeding of Farm Animals (Dairy Cattle)*, by J. C. Bonsma, Division of Agricultural Education and Research, is obtainable from the Editor of Publications, Department of Agriculture, Pretoria. Price 3d., prepaid.

Bulletin No. 229.—*Soft-Cheese and Cottage Cheese* (Second and Revised Edition), by G. D. le Roux, Division of Dairying, is obtainable from the Editor of Publications, Department of Agriculture, Pretoria. Price 3d., prepaid.

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[*Photo on Cover* : Fruit Farm, Western Cape Province.]

[NOTE.—Articles from *Farming in South Africa* may be published provided acknowledgment of source is given.]

G.P.-S.8899—1948-9—8,150.

LOOK AHEAD!

New Year Message from the Honourable S. P. le Roux, Minister of Agriculture and Forestry.

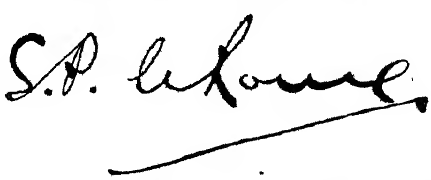
HUMAN activities do not come to a standstill with the changing of the years; there is merely a short lull—a pause for rest and contemplation of the past on which we must build. And then automatically, the new year links up with the old and almost unnoticed we find ourselves once again engaged in our life's task. Life is dynamic, and our gaze should always be directed at the future—at the task which we are called upon to fulfil.

The year 1948 is at an end and 1949 is here. In other words, the short pause is over and you, members of our farming community, are once again in the midst of the activities entrusted to you. I need hardly emphasise the importance of these activities.

In this message to the readers of "Farming in South Africa" I wish rather to emphasise the *necessity for constantly looking ahead* while you are engaged in your important task. Your aim should ever be progressiveness, efficiency and more effective adaptation of your farming, and to achieve this your gaze should constantly be directed ahead—directed at all new things essential to the realization of this aim. The past is the source of experience, but the future demands study and investigation.

Furthermore, your task is very closely bound up with the future development of South Africa. The maximum utilization of our agricultural potential has in no wise been realized yet. It is essential that you should gain a new insight into matters and keep abreast of new means of development.

To all of you who are associated with the agricultural industry, I extend my best wishes for a happy and prosperous New Year.



Minister of Agriculture and Forestry.

A Higher Standard of Education for the Young Farmer.

A. J. Taylor, Senior Professional Officer, College of Agriculture, Cedara.

IN the Report of the Conference on Rural Education held in 1934, it was stated that: "58 per cent. of the children who pass out from the schools to find their living in agriculture have not passed even standard VI. They are without even the recognized minimum of education, and probably not 5 per cent. of those who go to make their living on the farms have any specific training at all for their work".

Report No. 4 of the Economic Planning Council entitled, "The Future of Farming in South Africa", published in 1944, contains the following statements: "Productive efficiency and educational attainments are closely linked . . . During the last ten years 450 Europeans graduated yearly in agriculture or attended agricultural schools or colleges. It is evident that, with approximately 100,000 farms, the industry requires an annual influx of far more than 450 technically trained persons if farming is to be improved rapidly . . . The great progress in Danish farming coincided with the remarkable progress in Danish education since the last quarter of the previous century".

"FARMING IN SOUTH AFRICA" IN LARGER FORMAT.

As from the January issue *Farming in South Africa* will appear in larger format.

The "Farm Home Section", which has appeared for many years in *Farming in South Africa,* will be converted into a separate women's journal, *The Woman and Her Home,* the first of which will appear in January 1949.

The subscription to this journal will also be 5s. per annum, prepaid to the Government Printer, Bosman Street, Pretoria.

Information gleaned from other sources confirms the fact that the majority of boys taking up farming as a career have not gone beyond standard VI. Present-day enrolments at the University Faculties of Agriculture, at the Colleges of Agriculture and at the Agricultural High Schools cannot provide more than 400 new entrants to farming each year.

This is a serious position for agriculture in South Africa. In almost any other walk of life, in any profession or trade, for example medicine, law, carpentry and mechanics, those wishing to practise such a profession or follow such a trade must not only have a stated minimum standard of education, but must also have followed a prescribed course of professional or vocational training. Yet anyone can become a "farmer" without any previous special training or without any minimum standard of education.

The untrained and incompetent man on the land—he can hardly be termed a farmer— not only risks any capital he may possess or borrow but, what is far more serious, will waste the country's capital by bad farming methods. Soil erosion with all its attendant evils is one result of bad

 Continued on page 798.

FARMING IN SOUTH ...AFRICA

VOL. 23 DECEMBER 1948 No. 273

Editorial:

Plan now for Future Price Relationships.

SOUTH AFRICAN agriculture is about to enter the tenth year of a period of sharply increasing prices which started in 1940. This is the longest period of rapidly increasing prices through which our agriculture has passed during the past hundred years—the period for which scientifically calculated prices are available. Not only is this the longest period of an upward price trend, but also one in which all former price peaks were topped, namely, the peaks in (*a*) the 1870's, (*b*) the Anglo-Boer War, and (*c*) the period after the end of the First World War.

In spite of the strict application of price-control measures, the price index of field crops and animal products has reached the high level of 233 for the year 1947-48—the index for the few pre-war years being 100. During the past few months further price increases have been registered. Production costs naturally did not remain constant, but owing to the cost structure in agriculture, this period of fast-increasing prices has been accompanied by an increase in the profit margin of agriculture as a whole. This is typical of a period of rising price levels.

At the same time the inflation process in agricultural land values still continues. The index of agricultural land prices for the year ending 31st March, 1948, reached the peak of 272. It appears, therefore, that land prices are moving ahead of the prices of agricultural products. Herein lies at the present moment one of the chief dangers to our farmers and our soil.

Although many people have risked forecasting future price tendencies, it must be understood that the economist is no prophet and that the forecasting of price trends at the present moment is rather a risky undertaking. There are, however, sufficient reasons to accept the view that the present high price level for farm products cannot be maintained. These reasons are too numerous to be discussed here in detail.

Farming, to-day, is more than ever an intricate business, requiring an average capital investment of several thousands of pounds. In fact, a capital investment of £10,000 in a farm is to-day only an average or even below-average investment. This being so, the farmer has to consider the future when planning his business, and being forced to do this, he must form some idea of the general price level during the next decade.

Unless another world war awaits us, it will be the safest to assume that, after so many years of increasing prices, a cessation in the upward price trend cannot be far remote. The time has, therefore, arrived to start planning the farm for a period of declining profit margins. If such a policy is followed the farmer will not be caught unawares with changed and less favourable price relationships.

Plans requiring, at this stage, a large outlay which cannot be paid for within a reasonably short period, say one or two seasons, should be undertaken very cautiously. The most important long-term undertaking in the farmer's life is the buying of the farm. Under present conditions it is far safer to hire than to buy, especially if a high debt has to be carried. Do not allow yourself to be misled by rumours that present land values will be maintained forever. At the same time, do not sell your farm now, however alluring the price may be. Your farm is worth as much to you as to the other man, and your money will not be invested better in the city. Do not lend yourself to furthering the present speculation in agricultural land.

If you still carry any debt, whether a loose debt or a bond on your farm, pay it off as soon as possible. In times of declining prices, a debt has an increasingly strong strangle-hold on farming.

In times of high price levels and hence high profit margins, poor producers also show a profit and poor lands could be profitably put to cash crops. In the case of livestock enterprises where the period between breeding and productive use (e.g. milk cows) is relatively long, stringent selection with a view to high production should be applied immediately. It pays to keep only the most productive animals in times of less favourable price relationships.

Those who wish to start fruit farming, in other words a type of farming where the period between hole-digging and the marketing of the produce stretches over several years, should go about the problem very cautiously at this stage. The chances are that the price level will be considerably lower by the time the trees reach full bearing age. Avoid the mistakes made during the twenties and plan orchards only on suitable soil in established fruit areas.

During times of high price levels, specialized grain farming in one product will give good financial results. This is not the case in times of declining prices. In the latter case economic conditions (apart from soil fertility considerations) will indicate a change to greater diversification in the choice of enterprises in order that they can supplement one another in the use of relatively expensive labour and capital goods. Start organizing your farm now in such a direction, should you have deviated from it during the war period.

Do not buy new machinery blindly, merely to follow your neighbour. It may be that cheaper products will have to pay for the expensive machine. You will be forced to greater mechanization in future, but plan your mechanization carefully. Try to improve your mechanical knowledge because it is far cheaper to do a repair job on the machine yourself than to hire high-priced city labour for this purpose.

As we will be forced to greater mechanization in future, the farm mechanical unit will to a large extent determine the optimum size of the farm. We can, therefore, expect that many farms will have to be enlarged for this purpose. Consider this factor very carefully before you are perhaps lured by the present high prices into selling off parts of your farm. A farm business with a reasonable size (economic size) is one of the keys to financial success.

Start planning now for re-adaptation to changed economic relationships which may come. By doing so, nothing can be lost, but a lot can be gained.

(F. R. Tomlinson, Professor in Agricultural-Economics, Agricultural Research Institute, Pretoria.)

Wool, the Wonder Fibre.

J. C. de Klerk, Sheep and Wool Officer, College of Agriculture, Glen.

IN a previous article a short historical survey was given of Wool and the Weaving Industry; in this article the uses and physical characters of wool are discussed.

Uses of Wool.

Wool is an animal fibre perfectly designed by nature for protection of the body. Scant wonder, then, that throughout the ages, man has used wool for the manufacture of a variety of fabrics with which to clothe himself and protect himself against the cold and vagaries of nature.

It is impossible to detail here all the different kinds of material made from wool, and consequently a broad classification of woollen fabrics will have to suffice: —

(*a*) *"Hard-texture" wool fabrics.*—These wool fabrics are very firmly woven, giving the material a hard surface and designed to give strength and durability to the fabric. Examples of such fabrics are gabardine, serge, cheviot and others.

(*b*) *"Soft-texture" wool fabrics.*—As the name implies, such fabrics have a soft surface produced by a process known as "napping" whereby the fibres are raised on the material. Flannel is a typical example of this class.

(*c*) *"Crêpe" wool fabrics.*—These fabrics depend more upon the type of yarn used than on the type of weave. The twist in the yarn may be either 'right' or 'left'. Crêpe material is obtained by using such yarn, twisted to left or to right, with anything from 45 to 75 twists and more per inch of yarn, alternately for both weft and warp. The texture may be either hard or soft and, as a rule, very light materials are obtained in this way.

(*d*) *"Tweed" wool fabrics.*—The original tweed was obtained from wool of the Cheviot-sheep and processed on the River Tweed in Scotland—although some maintain that it was in the town of Hawich on the Teviot River. To-day we get a large variety of Tweeds, such as Shetland, Cumberland, Irish, Harris Tweed and others.

It is not easy to describe a tweed, yet the expert in textile wares will never err in owning a tweed. It may perhaps best be described as a "fancy woollen cloth" in which the colouring of the resultant texture is begun in the processing prior to weaving and by the manipulation of the various colours in the warping and weaving.

Tweeds are particularly popular as men's sportscoats and ladies' costumes.

(*e*) *"Coating" wool fabrics.*—These fabrics are specially designed for maximum heat-retaining qualities, and the fibres may be long or short, with the yarn fairly loose, and not so firmly twisted. In this category may be included "Astrakhan", "Velour" and "Melton".

(*f*) *"Nubby" wool fabrics.*—Two or more yarns twisted together i.e. plied yarns, are used for this fabric. The yarns vary in thickness and are twisted in such a manner that when the fabric is woven, small knots

protrude on the cloth. The well-known bouclé comes into this category of woollens.

(*g*) *"Sheer" wool fabrics.*—These are light, loosely woven fabrics made of very fine yarns. Bunting, used for flags, and voile are good examples.

(*h*) *"Knitted" wool fabrics.*—Wool is a very popular fibre for knitted fabrics, and these are so universally known that any description would be superfluous. Underwear, socks, cardigans etc. are well known examples which fall under this group.

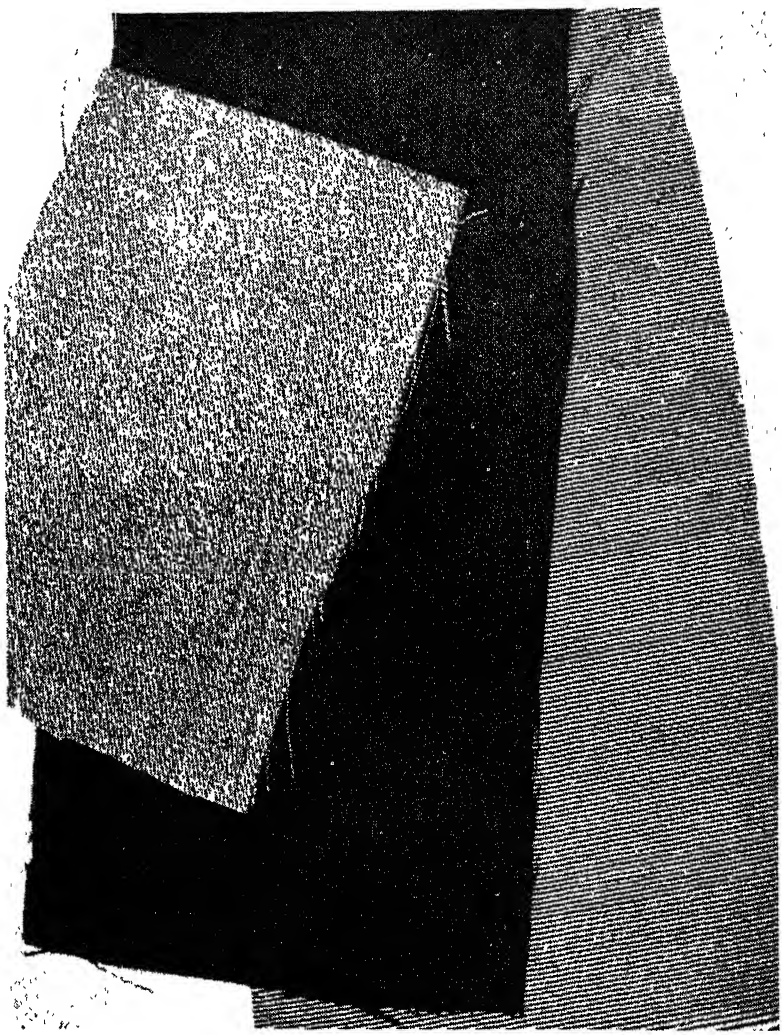


FIG. 1.—*From left to right.*—Gabardine, Serge; Poplin.

(*i*) *"Felted" wool fabrics.*—Wool is one of the fibres which lends itself best to felting, i.e. material may be made from it without first having to spin it into yarn or weaving it into cloth. Felt hats are common examples.

(*j*) *"Cheviot" and "Saxony".*—The terms 'cheviot' and 'saxony' are frequently used in connection with clothing materials. This commotes a broad division of all textiles into two main groups, viz, textiles made of merino wool, known as 'Saxony', and textiles made from wool, other than merino wool, known as 'Cheviots'. Cheviots thus include all wools below 58^s spinning counts, with the exception of carpet wool of 32^s spinning counts and lower.

Physical Characters of Wool.

(*a*) *Elasticity.*—The ideal fabric should not tear easily or lose its shape when stretched or strained, and should, after use, assume its original

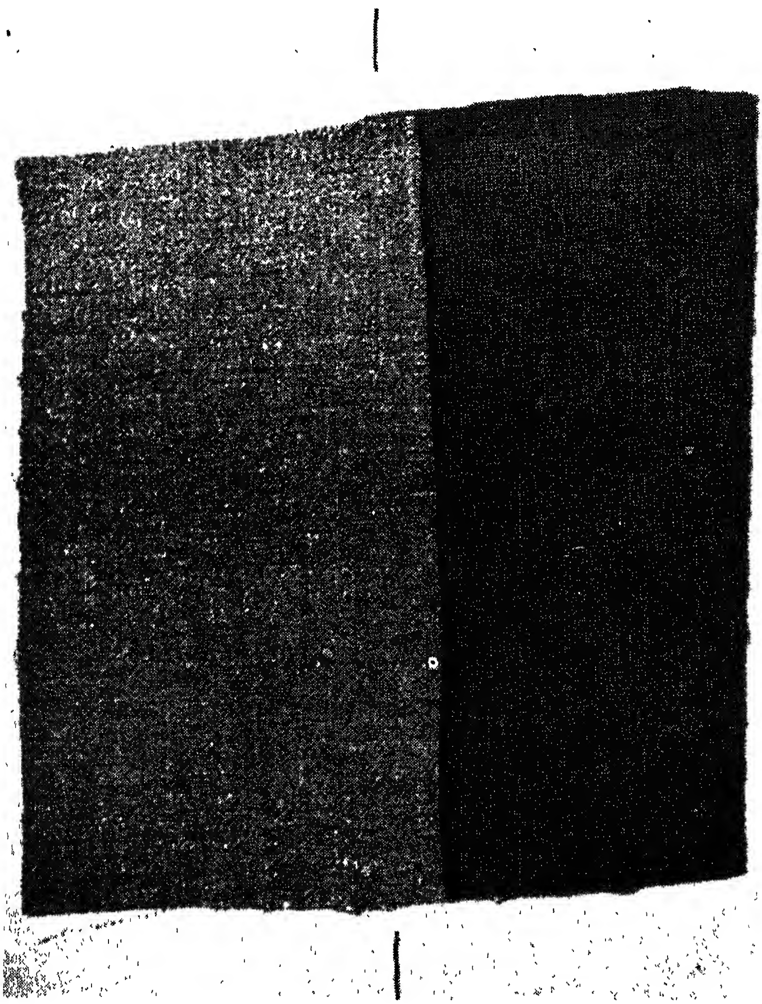


FIG. 2.—*From left to right.*—Flannel; Afghalain.

shape of its own accord. It should not crease readily, and must readily remove all creases by its own natural properties.

In order to comply with all these essentials, the fabric must be elastic, and *wool is perfectly elastic.* No matter how much it is stretched,

(provided, of course, it is not stretched to breaking-point) it will return to its original position. This character gives to wool that resistance to creasing and excellent draping qualities so in keeping with popular fancy; woollen goods are indeed always smart, neat and serviceable. Woollen clothing neatly folded and packed away, will always return to its original shape, and this is possible only because wool is elastic.

(*b*) *Strength.*—A good fabric should be able to withstand strain and heavy wear. The fibres should not break for example, when subjected to much bending, and should not rupture when under strain.

Wool is very strong even when wet. In fact, it is claimed to be as strong as metal, as the following figures indicate:—

Material.	*Tensile Strength.*
Copper	18 tons per square inch.
Gold	17 tons per square inch.
Aluminium	12 tons per square inch.
Silver	19 tons per square inch.
Wool	17 tons per square inch.

(*c*) *Weight.*—The desirable material should not only be strong and durable, but also very light, since it is tiring to wear heavy clothes. Modern fashion demands light clothing fabrics and in this respect too, wool does not fall short, since it is actually lighter than artificial silk, as the specific gravity of the following materials indicate: pure silk 1·25, wool 1·32, cotton 1·54, acetate artificial silk 1·33, Viscose and Cuprammonium 1·52.

Because the specific gravity of wool is so low it is possible to spin from it very light yarns of as high as 120s spinning counts, i.e. from 1 lb. of top, 120 hanks or a length of yarn 120 × 560 yards, i.e. nearly 38 miles, may be spun. Already commercial woollen fabrics are obtained which weigh as little as 3 oz. per square yard, and, with the aid of certain artificial fibres, it will be possible in the future to manufacture woollen fabrics which will be even lighter and so make it most suitable for evening and tropical wear. Thus, wool is fine and light.

(*d*) *Heat-retaining properties.*—The heat-retaining properties of clothing are of the utmost importance. The body should not be exposed to rapid changes in temperature, and the natural heat of the body should not be disturbed—rapid changes in temperature are responsible for colds. The heat-retaining properties of a fabric are dependent upon the weave-structure and the heat conductivity of the material itself. If the weave-structure be the same, the conductivity for heat of the fabric may be determined from results obtained by research workers, e.g.—

Material.	*Conductivity for heat.*
Cotton	0·56
Silk	0·44
Wool	0·37
Cotton fabrics	0·80
Woollen blankets	0·43

Wool is a poor conductor of heat. Because of certain physical properties of wool, materials made thereof are extremely slow conductors of heat and are therefore able to retain the heat and keep the human body warm much better than fabrics made of other material.

Absorption of moisture by fibres, however, affects conductivity. Yet, Staff has proved that, when wool fibres become wet, the rapidity with

which they conduct heat is half that of cotton (provided they are equally wet). In other words, wool retains heat better than cotton, if both are equally wet. It may, therefore justly be stated that for its heat-retaining power, wool is unsurpassed.

(*e*) *Capacity for absorbing moisture.*—Underclothing worn next to the skin should not feel clammy, but should give a feeling of dryness and comfort. The natural perspiration of the body should be readily absorbed and retained in the fibres of the fabric, and on a change in temperature will not produce condensation of moisture causing discomfort due to cold or clamminess.

Capacity of different textile fibres for absorbing moisture.

Material.	Under ordinary atmospheric conditions.	100 per cent moisture content.	95 per cent moisture content.
	lb.	lb.	lb.
Pure silk	11·0	33	21·5
Cotton	8·8	33	18·0
Viscose artificial silk	16·0	—	—
Acetate artificial silk	7·6	—	—
Flax	12·0	—	—
Wool	16·0	33	25·0

* Viz., the Weight of Water which can be absorbed by 100 lb. of dry material.

These figures show that, under ordinary circumstances, wool is able to absorb considerably more moisture than the other fibres, with the exception of Viscose artificial silk. At a humidity of 100 per cent there is no appreciable difference, but at a humidity of 95 per cent wool has a distinct advantage.

Under conditions of high humidity and a rapidly falling temperature, the moisture in all fibres, with the exception of wool, tends to condense into minute particles of moisture. This explains why woollen underclothing is free from clamminess which is not the case with other fibres which do not have such a high moisture-absorption capacity.

Wool also retains its moisture longer than do other fibres, and this fact coupled with the fact that woollens are poor conductors of heat, explains why wool maintains th most even temperature on the skin. *Thus, wool absorbs most moisture and retains it the longest—it, therefore, never feels clammy.*

(*e*) *Power to produce heat.*—The first essential for a well-aerated garment is that it should feel 'warm' and not cold or clammy. The material should give off heat as soon as it absorbs moisture or perspiration from the body, otherwise a cold feeling will result.

When wool becomes wet, it gives off a considerable quantity of heat and comparative tests have shown wool to be the best of all clothing fibres in that respect.

One pound of absolutely dry wool will give off, when entirely wetted, enough heat to raise one pound of water through 43° F. This capacity of wool to give off heat explains why a person, on having dried himself with a towel and put on woollen underwear, immediately feels warm and comfortable. Thus, wool creates heat.

(*g*) *Ultra-violet transmission.*—These rays must reach the body to keep it in a healthy condition and they function best when the body is warm.

The capacity of different clothing materials to transmit these healing rays have been discussed from time to time, and sometimes extravagant claims have been made. A very thorough investigation has, however, been made of the question and it has been shown that, if the material be of equal thickness, wool transmitted more of these rays than the other fabrics tested, such as cotton and certain artificial silks. Woollen material packed

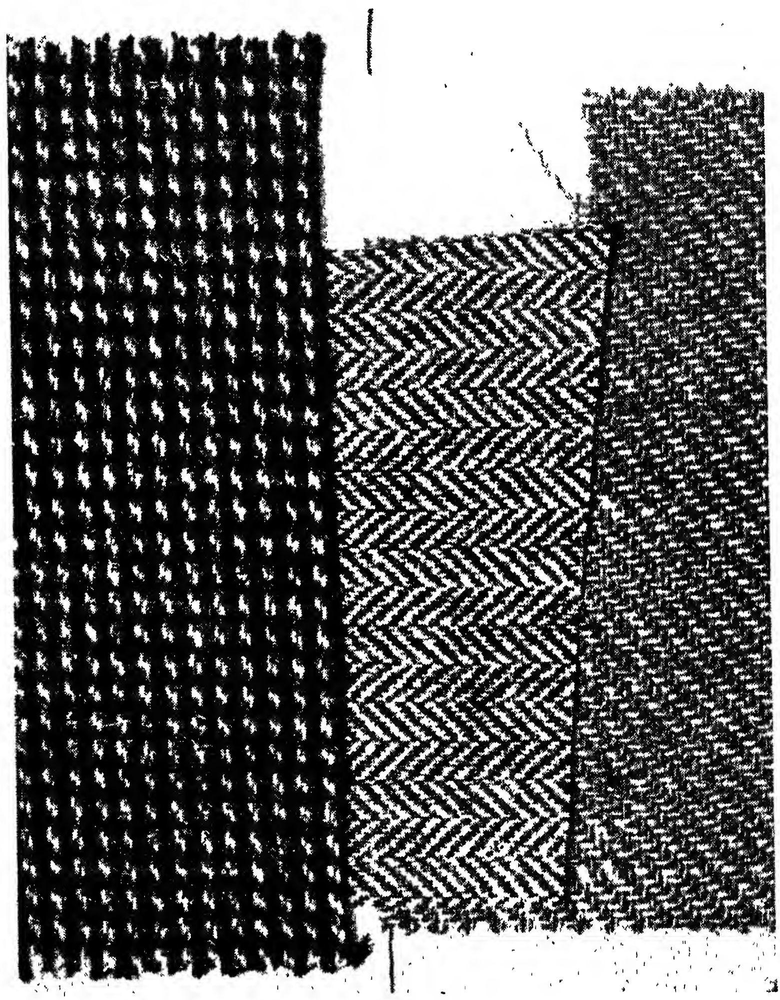


FIG. 3.—Tweed Materials.—*from left to right*—Harris; Herringbone and Homespun.

in layers (thickness of 0·48 mm. per layer) will exclude the violet rays entirely when the thickness is ¼ inch, whereas certain artificial silks would not transmit the rays when the thickness was only ⅛ inch.

Thick woollen clothing will therefore not exclude the violet rays so essential to health. Wool transmits "health" rays.

(*h*) Wool and hair are the natural covering of all mammals. It is interesting to note that the old, primitive sheep had two coverings, viz., an outer hairy covering consisting of hair, and an under-covering consisting of wool. By careful breeding and selection the outer hairy covering was gradually eliminated and the under-covering at the same time developed to what to-day is known as wool. Thus, wool is the natural clothing material.

(*i*) *Lustre and Softness.*—Wool fibres have a lustre peculiar to wool alone; it is not artificially bright, and yet it has a soft, attractive glossiness which nature alone can supply. Apart from this, wool has a delightfully soft, attractive feel and handle so essential to hosiery wool. A sensitive skin requires very soft material, free from coarseness. Wool, and particularly fine wool, complies with these requirements for softness and handle.

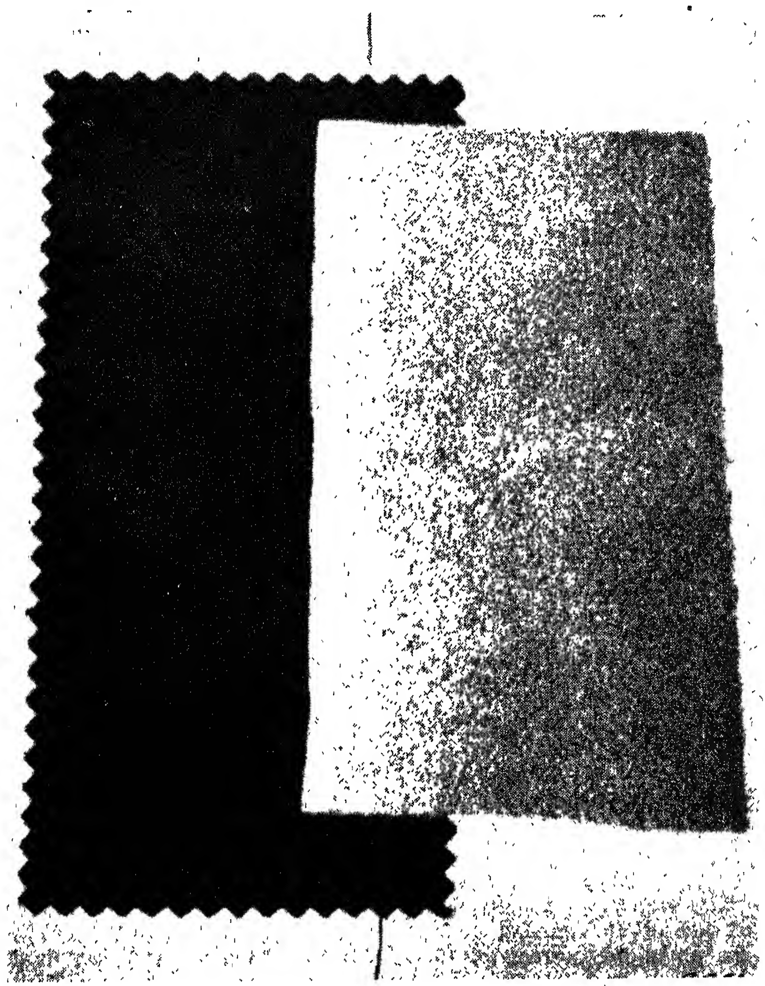


FIG. 4.—*From left to right*—Melton; Velour.

(*j*) *Durability.*—It would be difficult to determine scientifically the wearability and serviceability of different cloths, yet the life of woollen fabrics is well-known. Strength and durability are indissoluble and, as indicated, wool has these properties to a high degree.

The following data, however, may serve to indicate the durability of woollen materials gleaned from U.S. Army statisticians in the First World War.

Material.	Serviceability in months.	Replacements per man during year.	Original issue per man.
(i) Cotton Goods—			
Trousers	7	2	4
Shirts	7	2	4
Shorts	2	6	6
(ii) Woollen Goods—			
Trousers	14½	1	2
Shirts	6	2	2
Shorts	10	1	2

(*k*) *Wool is not inflammable.*—Woollen articles will not ignite in close proximity to fire; as against this, fibres of cellulous origin will immediately burst into flame. In this respect wool may be regarded as very much safer for hearth, home and person than many other fibres.

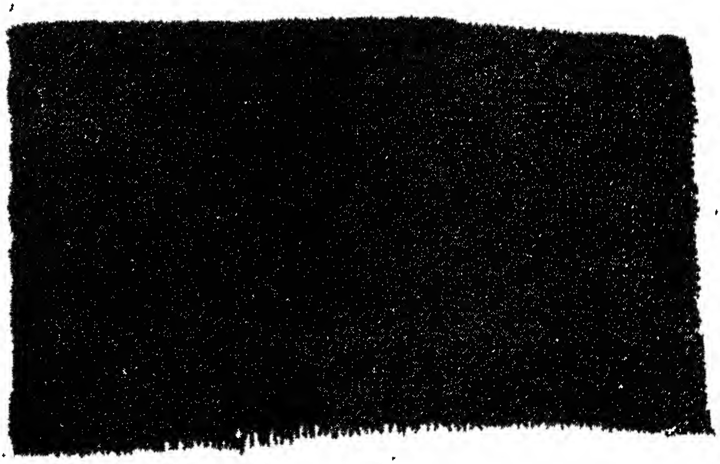


FIG. 5.—Bouclé.

Next to correct and adequate food, clothing is the most important requirement of the human body We are, however, perhaps better informed about the correct feeding of mankind than about his clothing; we know, for example, that our daily food should include certain quantities of carbohydrates, minerals etc., as well as the essential vitamines. In respect of clothing we have not yet advanced so far. Nevertheless, however, we know that the ideal textile fibre must comply with certain essentials and, as has been shown in the foregoing, wool satisfies these requirements in a high degree. It may justifiably therefore be said that wool is winter's best friend. Wear wool to protect your health.

[Continued on page 798

Potatoes as Stock Feed.

H. P. D. van Wyk, College of Agriculture, Potchefstroom.

THE Union annually produces thousands of tons of potatoes which are used principally for human consumption. The indispensability of this valuable and palatable dish for humans is emphasized whenever prices soar during a potato shortage. On the other hand, potato farmers are only too well aware of the precariousness of this crop as a cash crop when the supply exceeds the demand and prices drop so low that it is not worth while lifting the potatoes. At all events, the cultivation of this valuable food will continue to develop on a large scale.

In the production of potatoes there are usually large quantities which are unfit for human consumption, as well as a large percentage which are under-grade. Price fluctuations are frequently influenced by the placing on the market of large quantities of these low-grade potatoes.

If these potatoes could be effectively utilized for purposes other than human consumption, price stability may perhaps be promoted. Some producers use these potatoes for stock feed, and these persons already have a good idea of the value of this product in this respect. A wider knowledge of the nutritive value of potatoes as stock feed and the ways in which they could be used, would perhaps result in more effective utilization of this product.

Nutritive Value of Potatoes.

The value of the potato lies in its high content of digestible carbohydrates, and hence in its capacity for supplying a large quantity of calories.

Producers are not always in a position to utilize potatoes as stock feed and persons purchasing potatoes for that purpose should see to it that the prices they pay are in proportion to the nutritive value of the product. It is necessary, therefore, to be very clear on the nutritive value of potatoes in comparison with that of other feeds, in order to avoid paying prices out of all proportion to their value.

The table below shows how potatoes compare with other well-known feeds. The value is indicated in terms of digestible proteins and total digestible nutrients per 100 lb. In a separate column the total digestible nutrients, calculated on an absolutely dry basis, are shown:—

Plant.	Dry Material. %	Digestible proteins. %	Total Digestible Nutrients. %	Absolute dry basis-T.D.N. %
Potatoes	21·0	1·1	17·3	82·4
Mangold	9·4	1·0	7·3	77·7
Maize silage	28·3	1·3	18·7	66·1
Teff hay	90·0	4·2	53·1	59·0
Lucerne hay	90·4	10·6	50·3	56·0
Maize (grain)	88·5	7·4	83·7	94·5

The particularly high percentage of total digestible nutrients is clear from the table. In fact, the potato is one of the most valuable of tubers as food for man or beast. Since it is so extensively used as a food for

humans, it is obvious that it is impossible to use it very extensively as a stock feed. What we wish to encourage, however, is the greater use of inferior potatoes in animal rations.

The value of potatoes is further enhanced by its high production per morgen of nutrients.

In regions where this plant thrives well and is extensively cultivated, an average yield of 200 bags per morgen cannot be regarded as extraordinary, particularly when one considers that yields of as much as 400 bags per morgen are obtained. When the yield is 200 bags per morgen, the total digestible nutrients are 5,190 lb. per morgen, as compared with 4,185 lb. furnished by maize with a yield of 25 bags per morgen.

Potatoes have a low fibre content and are particularly palatable and, in addition, most digestible. Experiments with oxen have proved that 88 per cent. of the dry material is digestible if fed in the raw state. In the case of pigs, digestibility is further promoted by boiling the potatoes. Unfortunately potatoes are relatively poor in digestible proteins, and consequently potato rations for animals should be supplemented with the necessary proteins and minerals.

Potatoes and Stock Feed.

Potatoes are an excellent feed for all types of farm animals, including pigs, cattle, horses, sheep and even fowls. They may be used during the dry winter months as a succulent feed in the place of root crops or silage. They are rich in starch and consequently are eminently suitable for fattening purposes. Generally, it may be accepted that 4 lb. of potatoes have the equivalent value of 1 lb. of maize and may, in this proportion, partly replace maize in rations.

Cattle.

The tubers may be fed in their raw state. It is, however, necessary to put them through a cutting machine first to prevent their lodging in the animal's throat. It is also desirable to remove all adhering soil and tubers that show any signs of decay before feeding the potatoes to the animals.

The quantity fed to bovines is usually limited to approximately 50 lb. per head per day. As a rule this quantity corresponds to that of silage and other succulent feeds; otherwise, it may be calculated at about 3 lb. per 100 lb. live-weight per day. As in the case of all rations, it is also necessary to begin with small quantities and gradually to increase them until the maximum is reached.

Green tubers and shoots are dangerous to feed. The shoots may be removed, if potatoes which have already sprouted and are *not* green are available.

Horses.

Horses make good and effective use of both raw and boiled potatoes, provided the potatoes are sound and free from soil. The quantity of unboiled potatoes fed to horses is usually limited to 15 lb. per horse per day, while the quantity of boiled potatoes may be increased to 25 lb.

Pigs.

Potatoes, in one form or another, are regularly fed to pigs in all parts of the world. This class of animal decidedly makes the most effective use of them. Although limited quantities of raw potatoes may

be fed with advantage to pigs, they are best when boiled. As already stated, potatoes may partly replace grain in the rations and that without sacrificing quality and rapidity of growth.

In general it may be recommended that pigs which are being fed for the market receive the following ration: ½ lb. fish meal or ¾ gallon of skim milk, plus 2 lb. ground cereal per pig per day and, in addition, as many boiled potatoes as they are able to consume. Otherwise the rule may be followed of replacing part of the cereal in the ration with boiled potatoes in the ratio of 4 lb. of boiled potatoes to 1 lb. of cereal.

Silage.

Since potatoes are a perishable product and cannot therefore be kept for an indefinite period, it will sometimes be convenient to conserve them in the form of silage. This will enable the farmer to regulate their consumption more effectively. Experience has proved that they can be successfully ensiled and also that in this form they are very palatable to farm animals. If it is intended to feed the silage to pigs, it will be desirable to boil the whole supply before ensiling it.

There are various methods of ensiling the potato, but according to results obtained, most success has been obtained when the potatoes have been ensiled with good-quality dry hay. The quantity of hay used is usually 25 per cent. of the quantity used per weight, i.e. 500 to 600 lb. of hay per ton of potatoes. It is best to put the hay and the potatoes through the cutting machine at the same time. This silage is very palatable and excellent for dairy cows. In this case it would perhaps be best to feed it after the cows have been milked; this will obviate taints in the milk. It may be fed in quantities of 40 to 50 lb. per cow per day, just as in the case of maize silage.

Dried Potatoes.

In countries where food is perhaps scarcer than here, and where potatoes are more extensively cultivated, research has been conducted in the dehydration of large quantities of potatoes unfit for human consumption. This product is then fed to animals in their rations in the form of meal, and it has been established that the dehydration process does not reduce its nutritive value.

In some processes the potato is not heated to boiling point and the product may therefore be regarded as unboiled potato meal. This product is less palatable than that subjected to higher temperatures and causes digestive disturbances when it constitutes 30 per cent. or more of the ration, especially in pigs. The dry potatoes when boiled during the dehydration process are very palatable and may be fed in larger quantities. Experiments have shown that this meal in rations for pigs may replace almost the entire green portion pound for pound, without sacrificing quality or rapidity of growth.

Where large quantities of potatoes are available and an inexpensive dehydration process can be followed, potatoes unfit for human consumption as well as those of low grade, may be dehydrated to great advantage. This may perhaps enable producers not only to utilize their product more effectively, but also to ensure an increased food-production in general.

Summary.

(1) Potatoes may be used to great advantage as a stock feed for all types of animals, including horses, bovines, sheep, pigs and fowls.

(2) For pig feed it is necessary to boil the potatoes first.

Continued on page 788.

The Control of Spotted Wilt of Tomatoes.

J. J. du Toit, Plant Pathologist, Stellenbosch-Elsenburg College of Agriculture, Stellenbosch.

THE disease known as spotted wilt of tomatoes is caused by a virus to which tomato plants are susceptible at all stages. Affected plants are distinctly recognisable by the severe stunting which occur as a result of infection with this virus. Usually the first symtomss are visible in the young leaves, which become yellowish green and tend to curl downwards. On further development of the disease, the growth of affected shoots is practically arrested and black spots develop on the leaves. Because of the latter, this disease is wrongly known to many growers as " rust " of tomatoes. Infection in the seedbed is of particular importance, as there is then excellent opportunity for the spreading of the virus to healthy plants.

Dissemination.

In nature, dissemination of and infection by this virus are mainly effected by a group of small insects known as thrips. These insects are very small, long, slender, black and are provided with small shiny wings. They are very active and are not easily detected by the unpracticed eye. While the insects are in the nymphal stage, they are yellow and not black, and this, and the fact that they are so active, make them very difficult to detect. But they are usually abundantly present on all tomatoes, common garden crops, grasses and other weeds. During their nymphal stage, the thrips may get infected with the spotted wilt virus by feeding on affected plants, which need not necessarily be tomatoes. When they reach the adult stage, they will be virus carriers and be able to inoculate healthy plants with the virus.

Control

In controlling spotted wilt in tomatoes the first step must therefore be to keep the thrips population as low as possible, and, secondly, to remove all infected plants from the land, so as to prevent the young thrips from getting infected.

Results of Experiments.

Particularly promising results were obtained in preliminary experiments in which the principles, outlined above, were applied. These experiments were carried out at Stellenbosch during 1946 and 1947.

The beneficial effect of the timely removal of diseased plants was particularly evident in the first and indicatory test during 1946. This control measure was therefore applied to all plots of the second experiment, and all the diseased plants were regularly removed twice each week. The differences between the results of the treatments, given in the following table, should therefore be ascribed exclusively to the differential effect of the insecticides with which the plants were dusted.

These results given in the table clearly indicate that the campaign against the thrips had not been futile, as the treated plots at the end contained, on an average, at least 25·88 per cent. to 30·30 per cent. more healthy plants than the control plots in which thrips had not been checked.

Results of second experiment (1947-1948).

Treatments.	Replications.	AVERAGES OF TREATMENTS. * Number of healthy plants on 19/2/48 left over out of 66.	Percentage healthy left-over plants.
4 per cent. Nicotine dust (applied weekly)..	8	43·5	65·91
0·5 per cent. Gemmaxane dust (applied once every fortnight)........................	8	44·5	67·42
5 per cent. D.D.T. dust (applied once every third week)............................	8	41·6	63·00
Control................................	8	24·5	37·12

P = 0·05—Significant difference 7·33 plants.
P = 0·01—Significant difference 9·68 plants.

* Actually the crop was taken from more plants, as roquing was stopped on 22 December, 1947, i.e. when the crop started to ripen.

According to the foregoing data, there was no significant difference between 4 per cent. nicotine, 0·5 per cent. Gemmaxane and 5 per cent. D.D.T. dust The treatment with D.D.T. is, however, preferred because treatments with this dust could be given once in three weeks, whereas the other dusts had to be applied at shorter intervals. The programme decided upon, therefore, is as follows:—

The Programme.

(a) Treatment of Plants in Seedbed.

(1) Use 4 per cent. nicotine dust, and dust the seedbed plants every second or at least every third day. Applications should be made very lightly and special efforts must be made to get some dust also on the lower surfaces of the leaves. Do not dust heavily, because the plants may then ultimately become so thickly covered with stale dust that they may be damaged. Much of the stale dust can, however, be washed off with a good overhead watering if necessary. (D.D.T. apparently has a deliterious effect on very young tomato plants, because of which 4 per cent. nicotine dust is preferred at this stage.)

(2) Keep the seedbed and its vicinity free of all weeds.

(3) Dust the remainder of the weeds in the near vicinity of the seedbeds with 5 per cent. D.D.T.

(b) Transplanting.

(1) Transplant only strong and healthy plants.

(2) Plant twice the number of plants usually planted to a given area; for example, if 36 inches apart in the row is the normal spacing, it should now be 18 inches. This is to ensure at least a normal number of healthy plants from which a crop may ultimately be taken after all the affected plants have been removed from time to time.

(c) Treatment after Transplanting.

(1) Dust one week after transplanting with 4 per cent. nicotine dust and follow with another two applications of nicotine at weekly intervals.

(2) Further apply 5 per cent. D.D.T. dust every third week. These applications should be made very lightly but evenly, so as to leave no untreated parts or even patches on any plant.

(3) It is imperative that the whole tomato field should be carefully examined every third day and that all affected plants should be removed immediately, even if only one leaf is visibly infected.

(4) Continue to remove affected plants until most of the fruits start to ripen. Roquing may then be discontinued. The stand should at this stage be thicker than would have been the case with original normal spacing—provided that the dustings and roquings had been diligently applied.

(5) Continue with dusting programme up to six weeks after the first picking, i.e. another two applications.

(6) Keep down all weeds.

(d) Additional Measures.

Plants should be staked or trellised. The rows must be wide enough so as to facilitate cultivation. Trellised plants are more easily dusted, saving much time and dusting material.

Requirements.

The following may further be mentioned as being important for successful dusting:—

(1) A good dusting machine in which the flow of dust can be effectively regulated.

(2) An intelligent labourer who is trained to dust correctly.

(3) 4 per cent. nicotine dust.

(4) 5 per cent. D.D.T. dust.

Potatoes as Stock Feed:—

[*Continued from page 785.*

(3) Remove all soil from the potatoes, as well as all tubers showing any signs of rotting, before feeding to the animals.

(4) Green tubers and sprouts are dangerous for all animals.

(5) Silage of good quality may be made from potatoes by ensiling them together with 25 per cent. by weight of any good-quality dry hay.

(6) Potatoes have a high nutritive value. Four pounds of potatoes are equivalent to 1 lb. of maize.

(7) Dehydration does not reduce the nutritive value of potatoes. In this form they may replace cereals pound for pound in rations for animals.

Veld Management in S.A.

Bulletin No. 278 „Veld Management in South Afrika " by J. D. Scott has recently been published.

Copies of this Bulletin are obtainable from the Editor of Publications, Pretoria, at 3d. per copy.

The Papaw and its Cultivation.

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THE papaw (*Carica papaya L.*) is an important horticultural plant cultivated to-day in almost all the tropical and sub-tropical countries of the world, for its fresh fruit and papain. In South Africa the papaw thrives best in a subtropical climate as found principally in the lowveld of the Eastern Transvaal and Natal, and to a lesser degree in the frost-free regions of the Eastern Cape Province.

As a horticultural plant, the papaw plays an important rôle in the Transvaal lowveld, where it has been cultivated for many years. Unfortunately, however, its successful cultivation is constantly being threatened by malpractices and problems.

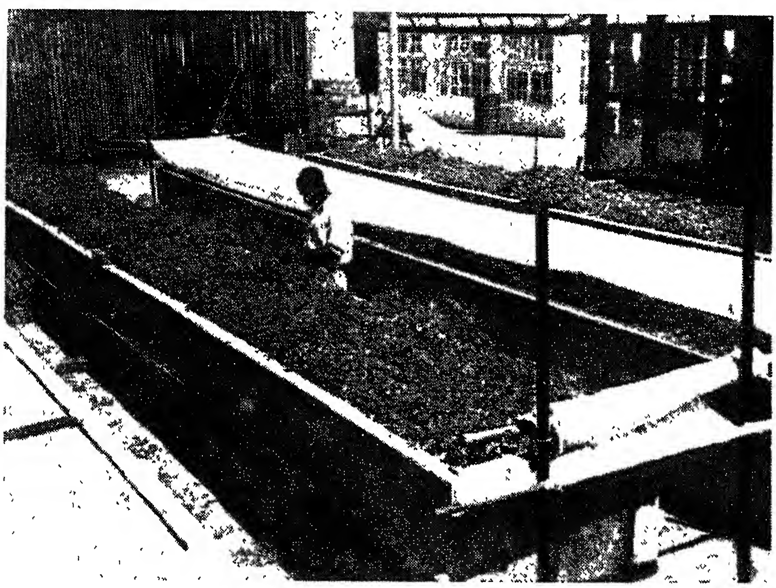


FIG. 1.—Seed-bed of pure sand. Notice the cheese-cloth covering.

These problems led to the commencement of an experiment to throw some light on the difficulties which are of such vital economic importance. The experiment was conducted during two different periods of the year, viz., during the autumn and during the summer. Similar methods were applied in both cases and are therefore discussed together.

A few of the problems met with in the cultivation of the papaw and which received special attention were:—

Seed-Bed and Germination.

A good stand of plants in the seed-beds is of great economic importance to the grower. Poor germination of the seed and loss of plants resulting from collar rot caused by the soil fungus *Pythium* are of very common occurrence.

Experiments were conducted with various types of seed-beds, after it had been established that the seed, as such, showed no tendency towards poor germination. Papaw seed of the "Hortus Gold" type was used for this experiment, since this type has for years been inbred and poor germination could therefore be expected, although this later proved not to be the case.

(*a*) *Seed-bed of pure sand.*—One type of seed-bed tested out was that of pure sand in trays as illustrated in Fig. 1.

Since sand is devoid of any nourishment, the plants were fed with culture solutions. Ordinary liquid manure was also successfully used instead of culture solutions.

(*b*) *Ordinary seed-bed with a layer of clean river sand on top.* In this case the ordinary seed-bed was used with a layer of clean sand, approximately one inch thick, overlying the entire surface. The seed was sown at a depth of about a half inch in this layer and covered with sand. No additional nourishment was necessary here, for as soon as the seed germinated, the roots penetrated through the sand and utilized the nourishment in the ordinary soil.

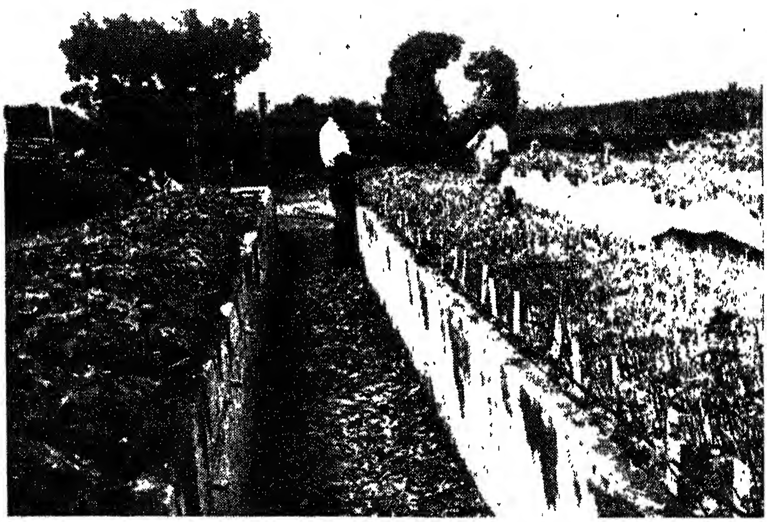


FIG. 2.—Defoliation of the plants in the seed-bed before transplanting.

(*c*) *Ordinary seed-bed.*—Growers generally use this type of bed. This seed-bed was used as control.

Results Obtained.

The seed-bed covering was made of grass and cheese-cloth. A portion of the seed was also treated with a commercial disinfectant in order to determine its effect on the germination.

The seed-beds which gave the best results were those with pure sand and the ordinary seed-beds with the layer of clean river sand.

The average percentage of plants derived from seed-beds of pure sand, for autumn planting, was 76 per cent.

No significant difference was noticed in the germination of the seeds previously treated with the disinfectant and those not treated. On the contrary, it appeared that the treated seed germinated more poorly. The structure of the testa of the papaw seed may be the cause of this poor

germination. Papaw seed has a rough, corky testa, and the fine disinfectant powder adheres to the seed in so compact a mass that moisture is not so readily absorbed, with the result that germination is either retarded or impeded. Thus, it would appear that papaw seed is one of the seed-groups which should not be treated with a powder disinfectant.

The number of plants finally obtained from the seed-beds covered with cheese cloth was considerably more than that from the beds covered with grass. The losses in the latter were very high as a result of collar rot which was very general in the grass-covered beds.

The average percentage of plants obtained from the seed-bed for summer planting was conspicuously less than that for autumn planting, viz., 60 per cent.

The smaller number of plants finally obtained for summer planting was dut to *Pythium* "Stem Rot". Fungicides were used, but they failed to have the usual effect, and this may partly be ascribed to the leaching by rain during the period.

FIG. 3.—A method of covering the plants with grass, after transplanting. This is the best method of protection and in many cases most practical.

During summer when temperatures and humidity are high, conditions are most favourable for *Pythium fungus*. The disease was particularly noticeable where the bed was covered with grass. Results from hessian-covered beds were much better. Where grass is used, a fairly thick layer is necessary if it is to be effective and such a layer of grass when it becomes wet, remains wet for a long time and effects ideal conditions of humidity for development of, and attack by the fungus *Pythium*. Hessian, on the other hand, dries comparatively rapidly, and the same harmful effect is not observed. Hence, for covering papaw seed-beds, some type of bagging material or other is recommended.

The type of seed-bed which gave very good results and which will be the most practical, is the ordinary bed with a layer of clean river sand

on top. The sand must, however, be completely free from organic material and ordinary soil.

The making of the seed-beds is also important but, on the whole, this aspect does not receive much attention. It is best to make the seed-beds at least six inches higher than the surrounding soil. In this way draining is aided and washing away of the beds during heavy rains prevented.

The quantity of seed required for planting one morgen of ground to papaws depends upon the espacement. For a 10 ft. × 10 ft. espacement ± 4 ozs. of seed is required, and for a 10 ft. × 6 ft. espacement ± 7 ozs. of seed.

Transplanting.

Transplanting from the seed-bed to the land has up to the present, usually been accompanied by serious losses of plants. If it is borne in mind that of the plants brought on to the land, 50 per cent. on an average are male plants, the importance of a thorough transplanting practice will be realized.

When transplanting, various troubles will present themselves if sufficient attention is not given to details.

It has always been recommended that the plants should be defoliated in the seed-bed before transplanting. By removing the leaves, transpiration is reduced until the roots are firmly established in the soil. Some of the plants were transplanted in full leaf in order to determine the importance of this practice.

The plants were transplanted as bare roots, i.e. no soil attached to the roots after the plants were taken up for transplanting. Some plants, after being transplanted, had grass coverings for protection against the sun, while others were left uncovered. On an average, 60 per cent. of the plants transplanted during the autumn and which, as control, were not defoliated, died on the land, in spite of the fact that they were covered with grass.

Excellent results were obtained with the bare-root method of planting. Only about 3 per cent. of the plants which were planted in this way died. The plants were transplanted to two different depths, viz., to the depth at which they stood in the seed-beds, and deeper. No difference was observed in depth of planting during the autumn, and both grew well. Practically all those plants, which were not covered with grass after being transplanted, died.

The transplanting results obtained with the summer planting differed considerably from that of the autumn planting.

None of the control plants which had been defoliated before transplanting, survived. The plants which were planted deeper than they stood in the seed-bed all died as a result of foot rot. The portion of the stem which, together with the roots, was below the soil is lighter in colour. As soon as planting is carried out deeper than the light portion of the stem, so that the green stem portion extends below the soil, it is attacked by the fungus. The plants which remained uncovered after transplanting all died as a result of the direct rays of the sun.

In order to save time, the bare-root method of planting may be applied, provided that great care is exercised. In this method, the plants are taken from the seed-bed and planted without any soil attaching to the roots. A tin or bucket of water, just sufficient to cover the roots entirely, gives good results; in this way the roots remain wet until the plants are planted.

The espacement so far adhered to, is 10 ft. × 10 ft. This is still recommended in rich soils, but in poorer soils trees never make sufficient growth to justify a 10 ft. × 10 ft. espacement. In the latter case an espacement of 10 ft. × 6 ft. is recommended and this, of course, means a few hundred more trees per morgen. The distance of 10 ft. between the rows is retained to facilitate cultivation with larger implements.

Espacements of 10 ft. × 10 ft. and 10 ft. × 6 ft. admit of 900 and 1,500 trees per morgen, respectively.

FIG. 4.—Papaw tree in bearing for the first time. Notice the height of the tree.

It is particularly in transplanting that most of the malpractices are met with. These malpractices are attended by heavy losses and are responsible for uneven stands. Many growers neglect to defoliate the plants before transplanting; scant attention is paid to the depth of planting, and even when the plants on the land are covered, it is done ineffectively.

Height of the Trees.

The productive life of the papaw plant in the Transvaal lowveld is from three to five years. Apart from the fact that after the third year

the crop diminishes, the trees have grown so tall during the last few years that there has been an enormous increase in the picking costs, one of the reasons for this being that ladders have to be used and more time is therefore taken up in the picking of the fruit. At that stage also, the tree, which has a weak fibrous stem, is more likely to blow over or to be damaged in some other way.

The practice of cutting down trees when too high is not recommended for the commercial grower. Since the papaw has a weak fibrous stem, the lateral branches which develop after such cutting are weak and break easily when fruited. It is also necessary to seal the wound to prevent decay. There are suitable preparations available in the trade. Such a cut-down orchard and the lateral branches formed will make cultivation in such an orchard very difficult.

Trees in the home garden may be pruned down if they grow too tall, but then the wounds should be properly sealed, and most of the lateral branches should be removed. Only two or three lateral branches evenly placed round the stem should be retained.

Young trees damaged by hail or otherwise, may be pruned down in this way. Fairly strong lateral shoots will develop, since the stem is still young and thin. Thinning-out of lateral shoots should also be done and this requires much labour.

Time to Plant.

The time for planting is closely bound up with the height of trees and the vigour can therefore be controlled by it. For example, if planting takes place in December, the plants still have four to five months for active growth before the winter. There is still vegetative growth during this period; in other words, the tree has attained a good height by the time it blossoms for the first time. If, however, planting takes place in March or early in April, the plants have only 1½ to 2 months for active growth before winter. In this case the tree is still comparatively small when it blossoms for the first time. The latter, and those planted during December, blossom at the same time, and for the first year there is comparatively little difference in fruit bearing. The orchard established in March can, therefore, be profitably maintained for at least a year longer.

Conclusions.

It is evident from the results that autumn (sowing in January, transplanting in March-April) is a more suitable time than summer (sowing in September, transplanting in December-January).

At first the autumn period presented many difficulties and could not be recommended. The limiting factor is the presence of the Bagrada bug which made planting during that period practically impossible. To-day B.H.C. (benzene-hexachloride) and D.D.T. are available and has made planting at this time possible.

The general tendency up to the present has been to sow early, viz., during September and then to transplant in December. From the results it appears that autumn planting can be recommended. By that time cooler weather has set in, and defoliation, covering, depth of planting, etc., so important during the summer, do not require the same degree of attention.

The time of planting, therefore, also has a bearing on the height of the tree.

Continued on page 814.

The Ascaris worm of Pigs.

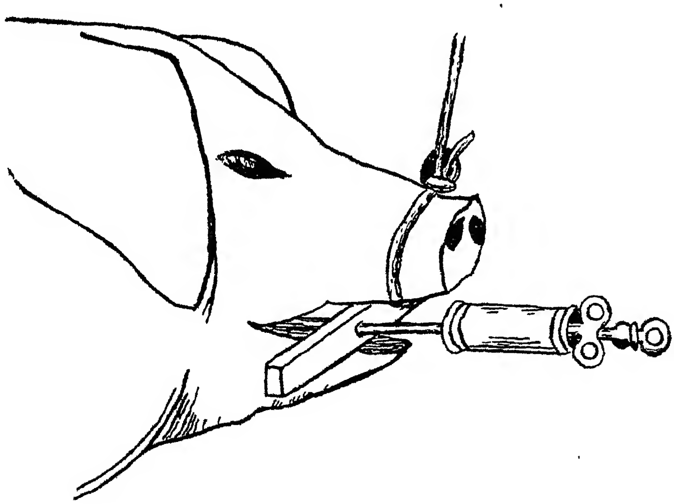
Dr. R. J. Ortlepp, Onderstepoort.

THE most important parasite of pigs is *Ascaris lumbricoides,* a large white worm which occurs in the small intestine of the pig, and attains a length of 10 to 15 inches and a thickness of ¼ inch. This worm occurs throughout the world, causing heavy losses.

Life History.

The female lays some 200,000 eggs per day, which are discharged in the faeces of the pig. The eggs develop rapidly on the ground and if it is hot they already contain larvae crawling about in the shells after 10 days; in cold weather, however, development is more gradual. As a rule, the eggs do not hatch before they are swallowed by a pig, but they are infectious as soon as the larva is formed.

The eggs are exceptionally tough and retain their viability for a few years. They are not affected by ordinary disinfectants or by frost or drought. It is only when they are exposed to hot, dry weather for a few weeks that the majority of eggs will lose their viability. Considering the large numbers of eggs produced by the worms, and the resistance of these eggs to destructive agents, it is not to be wondered at that a sty or camp can, in a short space of time, become so badly infested that great difficulty will be experienced in cleaning it again. Eggs of the worms have been known to retain their viability for five years on the veld.



Pigs become infected by swallowing the eggs with food or water, and eggs are transmitted to the young pigs when the teats of the sow are unclean. Earthworms are also known to swallow large numbers of Ascaris eggs, and pigs may become seriously infected through eating these worms.

When the egg reaches the intestine of the pig, it hatches, but the worm does not remain there. It bores into the wall of the intestine until it reaches the blood; it then travels along the bloodstream to the liver and from there to the lungs. In the lungs the worms break through the

blood-vessels into the bronchial tubes, whence they crawl up into the throat. The pig usually coughs them up with mucous and swallows them again. This extraordinary process lasts from one to three weeks. In this manner the worms are once again introduced into the intestine, where they undergo the final stage of development, the entire process taking about nine weeks from the time the eggs have been swallowed.

Symptoms.

The symptoms are caused in various ways. The young worms in the lungs do most harm, seriously damaging and weakening the lungs and rendering the animal very susceptible to bronchitis or pneumonia. The worms in the intestine eat away the inside of the wall of the intestine, causing sores; they move about a great deal and can crawl up from the intestine through the bile duct into the liver; they probably give off certain substances which are poisonous to the pig and if there are many worms they occasionally cluster together and block the intestine.

Full-grown pigs can swallow a large number of eggs without becoming infested, but young pigs are extremely susceptible and can pick up infection shortly after birth. Small pigs when infested cough and breathe with difficulty; they are listless, have no appetite and usually hide themselves in dark corners. They can easily die from such infection, and as a rule a number of them become infested at the same time. Piglets may also become infested before birth if the sow becomes infested during gestation as the larvae in the blood can be transmitted to the unborn pigs.

In cases of light infection the young pigs have a poor appetite, grow slowly, remain stunted, and cough at intervals. Older pigs becoming infested with the worms only become slightly thin; they may cough occasionally and are sometimes subject to convulsive fits.

Post-Mortem Appearance.

This varies considerably according to the age of the pig and the symptoms shown. In the case of young pigs the lungs show a number of small red dots, while the bronchial tubes contain mucous and sometimes show signs of blood or a creamy foamy liquid. The liver may also contain specks of blood, and young worms may be found in the intestine.

Older pigs are emaciated, while the bronchial tubes may contain a small quantity of turbid, greyish mucous, and worms may be found in the intestine.

Treatment.

The best remedies are *sodium fluoride* and *chenopodium oil* which may be obtained from a chemist or dealer.

Sodium fluoride is a powder which has been found to be very effective in combating the ascaris worm in pigs; the fact that it can be fed together with the pig's feed gives it this advantage over chenopodium oil that it eliminates the difficult process of dosing. Care should be taken to ensure that each pig is given the correct quantity, as a large dose may be dangerous. If possible, each pig should, therefore, be fed separately to avoid this danger. If this is not possible, care should be taken to ensure that only pigs of equal size eat from the same trough and that the trough is large enough to allow of their eating from it simultaneously without jostling one another.

The correct dose, (1 gram per 10 lb. live-weight) is weighed off and then thoroughly mixed with the day's concentrates or bran ration. Divide the day's ration into three equal portions: Feed the first portion in the morning, the second at midday and the last in the late afternoon. This

remedy has been found to be less poisonous if dosing is spread over a whole day. The feed may be slightly moistened, if necessary. Do not give any other feed before all the treated feed has been consumed, even if it takes two days. Water may be given after the first day. It is advisable not to give the pigs anything to eat on the evening before they are started on the treated feed. The dosages are given in column 2 of the table below.

As most farmers do not possess the right type of scale, they will be obliged to arrange with a chemist or some other person to weigh the doses off for them. To avoid this, however, another procedure may be followed, viz. to add 1 per cent. sodium fluoride to the full quantity of concentrates of bran feed to be given to all the pigs on one day; each pig would then obtain the amount of treated feed given in column 3 of the table below.

1. *Live weight.*	2. *Sodium fluoride.*	3. *Treated concentrates.*
20–25 lb.	2–2½ gram.	½ lb.
26–50 lb.	2½–5 gram.	½–1 lb.
51–80 lb.	5–8 gram.	1–1¾ lb.
81–100 lb.	8–10 gram.	1¾–2¼ lb.
101–150 lb.	10–15 gram.	2¼–3¼ lb.
151–200 lb.	15–20 gram.	3¼–4½ lb.
201 and over.	20–25 gram.	4½–5½ lb.

(1 ounce = 28 grams; 1 lb. = 450 grams.)

The accumulative effect of sodium fluoride on pigs has not yet been determined; it would therefore, be advisable not to dose porkers or baconers more than twice and to have an interval of at least two months between doses. Foundation sows may be treated twice annually, each time about two weeks before being served.

The above quantities are based on the commercial product which contains approximately 99 per cent. pure sodium fluoride.

Chenopodium oil is a liquid which has to be dosed. Unfortunately many inferior products are on the market and purchasers should look for an indication of the "ascaridol" content (which should be at least 60 per cent.) on the bottle. The dose is 1 c.c. chenopodium oil and 8 c.c. castor oil for every 25 lb. live-weight, and should never exceed 12 c.c. chenopodium oil even if the pig weighs more than 300 lb. The remedy is administered after the pig has been starved for about 12 to 18 hours.

Dosing may best be done with a suitable syringe fitted with a length of stiff rubber tubing. The head of a syringe needle may be cut off and fitted into the rubber tube to facilitate the attaching of the tube to the syringe. A hole is now bored through the centre of the large face of a strip of strong wood measuring 15 by 2 by 1 inch. Place the strip cross-wise in the mouth of the pig, push the rubber tube through the hole in the wood and inject the remedy into the back of the mouth. Large animals may be controlled by placing a loop of rope or riem through the mouth, behind the tusks, and raising the head by means of this loop (see illustration).

As the young worms crawl about in the liver and lungs for some time, when they will not be killed by this treatment, the pig should receive a second treatment about four weeks later, when such worms have returned to the intestine.

Preventive Measures.

There is no point in treating pigs and then leaving them in the infected stys or camps. After the first treatment they should be removed to a clean place. It is best, however, to wait three or four days in order

 [*Continued on page* 800.

Wool, the Wonder Fibre:—

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The Disadvantages of Woollen Materials.

Woollen materials have many virtues, yet it must be admitted that their physical and chemical properties are responsible for certain disadvantages too.

The following are a few of its disadvantages:—

(*a*) *Shrinking and Creasing.*—On account of its felting properties, wool will shrink on the application of moisture, heat and pressure. Thus, if woollen materials are not pre-shrunk, they will shrink when washed. There are three methods of preventing wool from shrinking, viz., (1) by treating with steam, (2) with cold water (London Shrunk) and (3) with chemicals. The last is the most effective method, since after the application of the first two methods, the material will still shrink when washed.

Woollen fabrics may also crease, but on account of the resilience and elasticity of wool, woollen clothes will again assume their original shape if hung in a well-ventilated wardrobe. Woollen materials are, however, also chemically treated to make them entirely crease-resistant. Further, they may be treated to render them water-repellent or even water-proof and fire-resistant.

(*b*) *Wool is an animal protein fibre* for which moths and carpet beetles have a predilection. Woollen fabrics may be treated to make them moth-resistant; some treatments give permanent immunity, but others have a temporary effect only.

(*c*) *Woollen materials are attacked by fungi* under favourable conditions which attenuate the fibres. They may, however, be chemically treated for resistance to such attack.

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A Higher Standard of Education for the Young Farmer:—

[Continued from page 772.

farming methods, and if so many of our potential farmers have only attained a low standard of general education and little or no actual training in agriculture, such bad farming methods can only be expected.

South Africa should, by taking the Danish experience mentioned above as both a warning and incentive, strive to raise the standard of education, both general and vocational, of the boys who will become the farmers of to-morrow.

Bumblefoot of Fowls.

J. D. W. A. Coles, Veterinary Research Officer, Onderstepoort.

ONE of the most tantalizing complaints of fowls is bumblefoot. It is not as a rule fatal, yet causes much trouble.

Occurrence.

There is practically no poultry farm where odd cases do not occur. On some farms, widespread outbreaks are experienced from time to time. The disease may be confined to one pen, even though birds in other similar or identical pens remain unaffected. In some years the condition on a farm may be very much worse than in others.

Cause.

A fowl becomes predisposed to bumblefoot when the foot is injured by stones, thorns, hard floors and perches with sharp edges. If the nests, food hoppers and perches are excessively high off the ground, bruising of the foot may occur when the fowl alights on the floor. Very frequently there is no obvious predisposing cause.

Whatever the prediposing cause, if any may be, it is certain that the vast majority of cases of bumblefoot arise directly as a result of a bacterial infection working into the ball of the foot around the margin of a corn. What produces the corn is uncertain, but a foot with a corn is more susceptible to injury, and so to the entrance of micro-organisms. Thus, there is a very close connection between corns and bumblefoot.

Symptoms.

The fowl is lame in the effected foot. If both feet are involved it will lie down and avoid walking as much as possible. A dark brown, sharply circumscribed corn is almost invariably seen on the ball of the foot. Pus may escape round the edges of the corn. The foot is usually warm, painful and swollen, and the swelling may be seen bulging up between the toes. Occasionally the swelling bursts at some point. The sinews and their sheaths running up the back of the shank may also be warm, painful and swollen.

Treatment.

Wash the foot thoroughly in a 1 per cent. carbolic solution. Pull the corn right out. Open up the ball of the foot and remove any cheesy matter present. Fill the cavity with sulphonamide powder, paint the whole foot well with ordinary tincture of iodine, apply a pad of cheap cotton wool to the ball of the foot, and then bandage properly so that the toes stick through holes in the bandage and move freely. Put the bird in a coop with plenty of litter on the floor, and it must not be allowed to perch, or jump off high feeding troughs, etc., till it is quite better. The foot should be dressed at least every second day. Complete healing usually takes place within a week or two.

If the sinews at the back of the shank are affected, treatment is seldom a success, and it is best to kill the fowl.

Prevention.

Endeavour to keep fowls off hard stony ground, or ground covered with thorns. Perches should be at least 1½ inches wide, with the corners rounded off, and they should not be higher than 2½ feet from the ground. The hard floor in the house should be covered with litter.

Examine any slightly lame fowl, as early treatment is usually simple and successful. Do not court possible trouble by putting an affected bird in with a pen of healthy birds.

Bumblefoot may occur *as a symptom* of tuberculosis, chronic fowl cholera, staphylococcosis and articular gout, but such cases are fortunately rare in South Africa.

If fowls are handled frequently, as they are when trap-nested, it is easy to pull out the small corns with the finger nails and so prevent bumblefoot developing.

Where trapnesting is practised, it is also easy to detect and treat mild cases of vent prolapse and fore stall vent picking. Finally trapping yields most valuable information about egg production, and without this knowledge no farmer can be a successful breeder of poultry.

The Ascaris Worm of Pigs:–

[*Continued from page* 797.

that the worms may first be excreted. Even then a pig may still carry away a number of eggs on its body and legs, and if it is possible to wash the animal, this should be done. Three to four weeks after being moved, the pigs should be treated a second time. The worms with which they are then infested will still be young and too immature to lay eggs.

Since a single treatment is not always sufficient to kill all the worms in the intestine, pigs which have been treated as described above may still carry infection to the new site, and for this reason it may be advisable, after the first treatment, to transfer them to a temporary sty, where a second treatment is given, and, finally, to treat them a third time at the place where they are to be kept permanently.

The pigsty or camp should be kept as dry as possible. Mud is not essential to pigs and it is better to combat Ascaris than to allow the pigs to have their mud and to become infested with worms, for these two factors are closely associated. Where worms would normally be very troublesome, the best results are obtained from stys with cement floors which are thoroughly cleaned out every week. In the case of the young pigs, which deserve most attention, the following course yields excellent results. Before the boar is allowed access to the sow, the latter is treated for worms. After being served, she should be placed in a clean sty or camp where there is little chance of re-infection. About a day before the sow is expected to give birth, she is washed thoroughly and transferred to a sty with a cement floor which has been very thoroughly cleaned with boiling water, caustic soda and a hard broom. Ten days after birth, the young pigs and the sow are removed to a clean land planted to turnips or some other suitable crop. Supplementary dosing of the sow a few days before her removal may be advisable, the object being to remove any worms which had not yet reached the intestine at the time of the first treatment. After weaning, the sow is removed and the young pigs will develop further in safety.

Strange pigs which are brought to a farm should be placed in a temporary sty and treated twice before being allowed to mix with the other pigs.

Summer Treatment of Vines.

A. M. du Plessis, Government Horticulturist, Oudtshoorn, C.P.

SUMMER treatment of vines implies such practices as the removal of superfluous little shoots (pre-thinning), the topping of shoots, fastening of shoots and ringbarking. The object of these practices, which are applied at different stages during the growth period, is to improve the quality of the fruit.

Thinning of Shoots.—Frequently a number of buds develop on the perennial wood of a vine from which short shoots sprout. These shoots usually bear few or no grapes, and a vine with such shoots is unnecessarily dense. The removal of these shoots while they are young and tender would, therefore, be to the advantage of both the vine and the fruit. The practice of cutting away these shoots is applied chiefly in the cultivation of table grapes, and is done when the oldest shoots have attained a length of 12 inches or more. The remaining shoots will then be able to develop more strongly, and the vine and the fruit will be more adequately aerated and ventilated. This will mean a healthier vine, and stronger bearer shoots for the next season.

Topping of Shoots.—During spring when the young shoots are still tender and are not yet dense enough to protect one another, strong winds may sometimes cause extensive damage by blowing off large numbers. The best developed shoots which are usually the best bearers and provide the best wood for the next season's bearers, are the first to suffer. Shoots developing in their place, are usually less fertile. Where there is the danger of damage by wind, the young shoots may be protected in the following way:—

(*a*) The tips of young shoots from 15 to 18 inches in length are pinched off or cut off with a knife (topped). In this way the shoot is arrested in its growth and the younger and shorter shoots are given a chance to catch up and help to protect the exposed shoots. Another advantage is that the topped shoot is able to establish itself more firmly at its base, where it emerges from the old stem. Yet a further result of topping is the development of lateral shoots and the consequent increase in the leaf surface.

(*b*) The actual topping of a vineyard is undertaken at a later stage, when the shoots have reached a length of several feet; the process is often repeated a few times, according to the luxuriance of the growth. In this case larger pieces of the shoots are slashed off with a "topper". The object of this type of topping is to give sunlight and air a better chance of reaching the fruit and to check the development of fungus diseases. The degree of topping is determined by circumstances. Trellised vineyards are topped less severely, or not at all, in cases where growth is not very luxuriant. Topping weakens the vine— it is summer pruning—and should not be applied to vines which grow poorly.

Fastening of Shoots.—This practice is applied mainly to trellised table grapes. The object is of course, to protect shoots and fruit against the wind which may blow them off or cause chafing and so reduce the quality.

Ringbarking.—This is a less common practice. Ringbarking means the removal of a ring of bark, one-eighth of an inch in width, below the lowest bunch. It may be practised either on the permanent stems or on the young shoots.

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Fowl Typhoid.

J. D. W. A. Coles, Research Officer, Onderstepoort.

FOWL TYPHOID is a specific acute bacterial disease of fowls and turkeys, and unfortunately is now also killing off chickens and poults in ever-increasing numbers. The disease is due to a small bacterium called *Salmonella gallinarum,* and the organisms are present in large numbers in the droppings which contaminate the soil, food and water. Some apparently healthy fowls are " carriers ". This means that their droppings contain the dangerous infection, although the fowls are not visibly ill.

Symptoms.

There is generally a sudden onset of the disease, and a large number of fowls may die within a week. The usual thing, however, is for two or three fowls to die each day.

The symptoms are:—Loss of appetite, increased thirst, dullness, ruffled feathers, head held close to the body, drooping wings, closed eyes and sleepiness. Diarrhoea is almost a constant symptom, the droppings being a greenish yellow. The comb is usually dark red to purplish-blue in colour, but in some cases it may be pale. There is high fever and the fowl is hot to the touch. There is also loss of condition and, finally, marked prostration, profuse diarrhoea and unconsciousness. Death may occur at any time within four days after the onset of the symptoms.

Post mortem Appearances.

At *post mortem* the liver is found to be enlarged and friable, and often has a bronze or greenish-bronze colour. Sometimes it may have a slightly mottled appearance, particularly in chronic cases of the disease.

The spleen is usually much enlarged. There is intestinal catarrh and even blood mixed with the intestinal contents.

Diseases Resembling Fowl Typhoid.

1. *Visceral gout.*—The spleen is never enlarged and the liver never has a bronze colour. Apart from these differences, however, the two diseases are easily confused.

2. *Spirochaetosis* and *Aegyptianellosis.*—Only a microscopic examination of the blood can reveal the causal parasites, which are transmitted by the tampan.

3. *Arsenical poisoning.*—There is generally thick tenacious mucus in the intestines and reddening of the membrane. A number of cases usually occur very suddeny. Chemical examination of the liver will reveal the arsenic.

4. *Bacillary White Diarrhoea in adult fowls.*—This is very rare, and only an expert can tell the difference.

In turkeys and fowls, whether young or old, the symptoms and lesions of fowl typhoid are always the same.

Prevention.

As all the ground rapidly becomes infected when once the disease has broken out, all survivors should, if possible, be put in houses and pens with concrete or other impervious floors. The safest measure is to

kill off and burn all fowls and turkeys the moment they become ill. This will reduce the infection still further.

Install dropping boards under the perches, and collect and burn or bury all droppings daily. Feed green food, mash, grain and water in receptacles into which the fowls cannot defecate. Before being fed, no food or water should come in contact with fowl droppings in any way.

The litter should be swept out and burned every second day till the disease stops, and the floor and dropping boards should be sprayed well with a 2 per cent. carbolic acid solution before the new litter is put in. Also change the nest-hay every second day.

Telegraph or write for fowl-typhoid vaccine immediately, and inoculate all fowls and turkeys at the earliest possible opportunity. The fowls and turkeys must not be allowed out for another fortnight, which represents the time taken for immunity to develop.

No dipping of the fowls or medical treatment is of any use, and it will pay to kill off and burn all sick poultry.

The successful eradication of typhoid diseases depends on a combination of:—

1. Hygiene, i.e., clean houses, uncontaminated food and water, and proper disposal of the faeces; and

2. Vaccination.—Farmers attend to vaccination, but almost invariably neglect the necessary hygienic measures, and it is for this reason that the vaccine is sometimes considered useless. Without good hygiene nothing can stop the disease from gaining even a greater hold on the country.

Farmers should be particularly careful not to buy fowls anywhere and everywhere, as they may be in the incubation period of up to 14 days. and so look quite healthy. A week or so later all the damage will be done. Since the B.W.D. test shows up carriers of both B.W.D. and fowl typhoid, farmers should buy all new stock from holders of the B.W.D. Test Certificate.

Since the droppings contain millions of fowl typhoid germs, it is very easy for fowl food sacks to become contaminated on a farm. For this reason fowl food should always be sold in new bags, or in bags that have been put in boiling water for five minutes. Naturally, the bags are dried before use.

Where the disease is established and vaccination seems to have no effect, the only thing for the farmer to do is to keep his fowls strictly on the intensive system, i.e., on an impervious floor, and to attend to the purity of the food and water, and vaccinate as well. The intensive system is also the main weapon of defence against other soil-borne diseases such as cholera, coccidiosis and worms, as well as diseases due to tampans and other external parasites.

Vaccination.

The vaccine, if unopened and stored in a cool, dark place, may be kept as long as two months. A hypodermic syringe, graduated in cubic centimetres, and six hypodermic needles are necessary for the operation.

Loosen the syringe, and boil it and the six needles for ten minutes before commencing to inoculate. Then tighten up the syringe, fill it with vaccine and begin. A pot of boiling water should be close at hand, so that a fresh needle may be used for each bird.

Inoculate under the skin of the breast. The dose for fowls and turkeys, irrespective of age, is 1 c.c. *A second inoculation, identical with the first, must be carried out a week later.*

Except when advised to do so by the Division of Veterinary Services, farmers should not inoculate poultry under two months of age.

When typhoid does break out in young chickens, they should be kept on ½-inch mesh wire netting. When they are two months old they can be inoculated, and a fortnight later they may be liberated in a new clean camp.

Farmers should, however, not wait for the disease to break out before inoculating their poultry.

Immunity generally takes 12 to 14 days to develop, and may be expected to last about nine months. The vaccine is harmless, and may be used whenever desired. If the operation is carefully performed, laying should not be affected. Vaccination does not render poultry unfit for human consumption.

Though vaccination can prevent the further spread of the disease, it cannot cure sick birds or clean up the infection in carriers. *Hence, vaccination can never completely eradicate fowl typhoid on a farm.* The only way to eradicate fowl typhoid completely is to have all the fowls and turkeys submitted to the B.W.D. test. As mentioned already, the one test eliminates carriers of both fowl typhoid and bacillary white diarrhoea. A separate pamphlet dealing with the whole question of B.W.D. is obtainable from the Director of Veterinary Services, Onderstepoort, or the Officer-in-Charge, Allerton Laboratory, P.O. Box 405, Pietermaritzburg. Generally speaking, it is not recommended that small farm flocks should be tested for B.W.D. The test is most useful for the owners of large flocks and the sellers of day-old chicks and breeding stock.

Vaccination is done entirely at the owner's risk, and the Department of Agriculture accepts no liability for any mortality that may occur as a result thereof.

The vaccine is put up in bottles containing sufficient material to inoculate 10, 25, 50 or 100 birds *once* and may be obtained on application to any District Government Veterinary Officer or Resident Magistrate, or direct from the Director of Veterinary Services, P.O. Onderstepoort (telegraphic address: Microbe, Onderstepoort); or the Officer-in-Charge, Veterinary Research Laboratory, Box 405, Pietermaritzburg (telegraphic address: Bacteria, Pietermaritzburg), at the rate of 5s. per 100 double doses, i.e., sufficient vaccine for the double inoculation of 100 birds. The vaccine for both inoculations is sent in one consignment.

Laboratory products are only issued on prepayment or c.o.d. per post or rail, but it will be to the advantage of applicants to remit cash with order, as otherwise, in addition to the cost of the articles, they must also pay the c.o.d. charges, which if the parcel is sent per post, may run into quite an appreciable amount, as the minimum is 1s. per parcel. Cheques, etc., must be made payable to the Director of Veterianry Services.

When replying to a letter or telegram always refer thereto by quoting the number and date thereof.

A New Bulletin.

Bulletin No. 284. The Feeding of Farm Animals (1. Dairy Cattle) has been published recently. It is obtainable from the Editor of Publications, Pretoria, at 3d. per copy.

A New Tomato Variety.

J. D. J. Hofmeyr,* E. A. Nel and F. C. Loest,
Subtropical Horticultural Research Station, Nelspruit.

THE new tomato variety "Hortus 5" which is eliciting considerable interest, was developed at the Subtropical Horticultural Research Station at Nelspruit. Articles on this tomato have already appeared in various popular journals, but the information given was incomplete. It is necessary, therefore, for the Department to furnish fuller information on "Hortus 5" tomato.

In Search of a disease-resistant Tomato.

The wilt disease caused by the fungus *Fusarium lycopersici* is proably responsible for most of the losses sustained annually by tomato farmers in the Lowveld. The breeding of tomatoes which are resistant

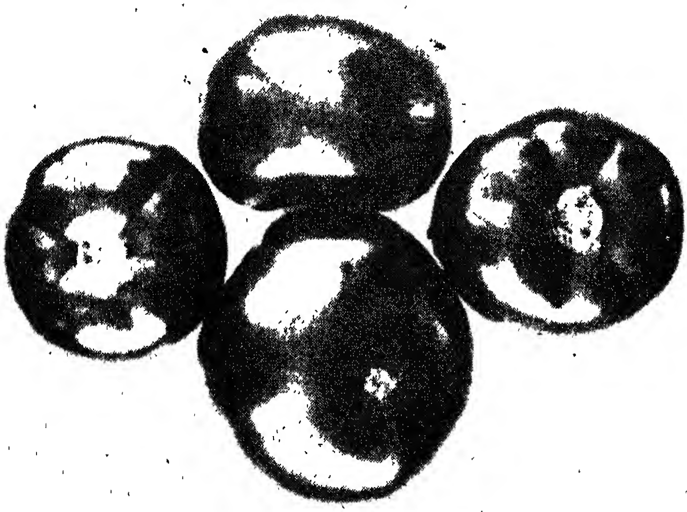

FIG. 1.—Typical fruit of "Hortus 5"

to this serious disease is, therefore, of more than ordinary interest. Moreover, it is useless trying to improve this plant by selection unless it has a certain resistance to the disease. Consequently, the chief aim in the breeding programme, since the establishment in 1927, of the Subtropical Horticultural Research Station at Nelspruit, has been the development of resistant tomato varieties. With this object in view, all the most important varieties, which had shown a high measure of resistance in America, were imported from time to time; but without exception, the varieties showed a greater degree of susceptibility at Nelspruit than in the country of their origin. The well-known variety, Marvel, showed a higher degree of resistance (Wager, 1934) than other varieties tested at the time, and was for ten years the principal resistant variety cultivated, especially in the Kaapmuiden region. The possible reasons for the waning popularity of this variety during the last few years will be discussed later.

* At present of the Agricultural Research Institute, Pretoria.

Breeding Operations.

Since 1934 Bohn and Tucker (1939) of the Missouri Experiment Station, U.S.A., have ben conducting extensive experiments with crosses between ordinary tomato, *Lycopersicon esculentum*, and a wild tomato, *Lycopersicon pimpinellifolium*, with the object of combining the greater resistance of the latter with the good marketing qualities of the former. In order to make their experiments as comprehensive as possible, isolations of the fungus were obtained from infected plants from various countries. Five isolations amongst others were also made from infected plants supplied by this Research Station in 1936. (See Bohn and Tucker 1939). The progenies of their crosses were infected with 43 of these isolates and from them selections were made which were entirely immune. According to these research workers immunity is determined by a dominant factor, its inheritance therefore being relatively simple. Small quantities of seed from these crosses were kindly supplied to the Nelspruit Station by Bohn and Tucker in 1940, but from experiments with these it appeared that the seed did not breed true to type, since the progenies showed segregation for plant characters, such as, the size of the plant, leaf shape, and the shape, colour and size of the fruit, as well as for resistance of fusarium wilt. Consequently, several generations were cultivated and from these, selections were made which were more true to type and which were pure breeding for immunity to the biotypes of the fungus used in the experiments. (Hofmeyr, 1942). Seedlings of these selections as well as of 26 well-known varieties were grown in sand cultures which were severely infected with spore suspensions of the fungus. These experiments were supplemented by observations of mature plants cultivated on severely infected soil. All the varieties appeared to be very susceptible, most of them showing 100 per cent. susceptibility, and Marvel was no exception. Yet, although some of the selections derived from the seed supplied by Bohn and Tucker showed susceptibility, others were entirely immune.

By testing the latter in a field experiment, for their horticultural value in comparison with Marvel, the most promising selections were chosen, and from these "Hortus 5" originated. For a number of years this selection proved immune from fusarium wilt disease, but unfortunately it has now developed a measure of susceptibility. Nevertheless, the degree of resistance, which it still possesses is much higher than that of the better-known commercial varieties in the region.

In 1946 quite a number of other types were noticed which showed variations in fruit and plant characters, indicating that this tomato was not yet pure. One of these variations, viz., with flat fruit shape is, commercially, the most promising. Plant selections were therefore carried out through four generations in an effort to obtain a more homozygous type.

Description.

As already stated, selection was principally made for he flat type and this is the predominating type in the variety, It should be stated, however, that this variety does not yet breed true to type for the desired shape of fruit, notwithstanding the fact that selection had been carried out already for so many generations. Hence, in a planting of this variety there will still be a small percentage of round, pear-shaped types.

An important fact which has emerged from these experiments is that resistance to fusarium wilt disease is evidently associated with the round and pear-shaped forms of the fruit. It will be remembered that immunity is

dervied from the wild parent, and that the round and pear-shaped type is a throwback to the wild parent. It is understandable, therefore, that the flat type of fruit which reverts to the domestic parent, will produce plants showing a measure of susceptibility to the disease.

The diameter of the fruit varies from $2\frac{1}{4}$ to $3\frac{1}{2}$ inches, and although the fruit is flat it is nevertheless comparatively deep, like the Marglobe type. The colour of the ripe fruit is bright red and that of the flesh somewhat paler. Unfortunately, however, the tendency is for delayed colouring at the stalk end. This defect appears to be specially noticeable under unfavourable climatic and environmental conditions.

When this tomato has coloured reasonably well, it lacks the firmness of, for example, the Marvel. In order to overcome this difficulty, growers are advised to pick them a little earlier than is usual in the case of the Marvel. It is necessary to point out that complaints about the firmness of the fruit usually come from those farmers who grow out-of-season tomatoes in the Lowveld region. This tendency is, of course, the outcome of unfavourable weather conditions and is encouraged by the fact that

FIG. 2.—Cross-section of "Hortus 5" tomato showing the well-filled locules.

higher prices are obtained for out-of-season tomatoes. Severe infection of the soil with both eelworm and the organisms causing bacterial and fusarium wilt disease are further fatal results of out of-season plantings—a practice to be discouraged.

The number of locules vary from 6 tot 12 per fruit and are well filled. Preliminary tests indicate that the solids of this tomato are appreciably higher than those of Marvel.

This variety grows luxuriantly but its foliage is more sparse than is desirable. In order, therefore, to reduce sunscald as much as possible, the tomato should be cultivated during the in-season period for the specific region. Take care, therefore, that the tomato does not suffer from a nitrogen dificiency. Inasmuch as fruit of different shapes of this tomato are still found, plant differences are also noticed. The variety grows fairly tall, though plants will still be found which are more pro-

cumbent and inclined to run. The fruit variations, viz., round and pear-shaped, are borne on these procumbent plants. The fruits of this variety appear in clusters.

The imperfections of this variety in respect of colour and firmness are readily admitted, and further breeding work has been commenced in an effort to surmount this difficulty.

General Discussion.

As stated above, the Marvel variety, cultivated on a commercial scale since 1931 especially in the Kaapmuiden region, has shown a fair degree of resistance to the disease. This resistance appears, however, gradually to have diminished, so that Marvel cannot now be considered to be a resistant variety. The increasing susceptibility to the disease may be ascribed to two possible causes, viz., either that Marvel has deteriorated in respect of its hereditary make-up and has thus become susceptible, or that biotypes of the fungus against which Marvel has no resistance, have increased. Owing to the self-pollinating nature of tomatoes and the purposeful efforts since 1930 at this Research Station to maintain its resistance by selection; the former may safely be disregarded as a possible explanation. If, however, new biotypes of the fungus to which Marvel has no resistance have developed by mutation, or have been introduced from elsewhere, they must have increased rapidly. Marvel, on account of its popularity, was cultivated over a wide area, so that the new forms of the fungus consequently could spread rapidly and assume an epidemic nature. This would then be the most logical explanation as to why Marvel in later years apparently lost its previous resistance.

A similar fate to that of Marvel awaits any new variety which is apparently highly resistant, and consequently its popularity can only be of a temporary nature. The presence and rate of spread of those forms of the fungus to which " Hortus 5 " is not absolutely resistant, must determine for what period this variety would be regarded as resistant.

As already indicated, the fungus *Fusarium lycopersici* exists in a number of forms which differ widely in the degree of their disease-engendering properties. While attacks of the most malignant forms of the fungus cause direct wilting and speedy death, the less malignant forms cause slow degeneration, viz., gradual yellowing of the leaves—a characteristic appearing first on the lower, and later on the upper leaves. This is followed by heavy defoliation, a noticeably stunted growth, shortened production period, and the production of fruit, a considerable percentage of which is too small to be profitably marketed as fresh produce. These are all typical results of the attacks on the plant of the weaker forms of the fungus.

Since the percentage of plants, which wilt fairly rapidly and die, is very small, farmers are inclined to underestimate their losses resulting from *Fusarium lycopersici*. The direct and indirect losses due to the weaker forms of the funges are very serious. The existence of the " Hortus 5 " tomato, with its relatively high resistance, is therefore of inestimable value to tomato farmers in those regions which are harassed by fusarium wilt disease.

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The Dairy Cow and Summer Heat.

P. J. Niemann, Assistant Professional Officer, College of Agriculture, Potchefstroom.

DAIRY cows suffer more from summer heat than is generally realized. This has been proved in practice and also by experiment. Heat has been found to affect the body temperature and rate of respiration adversely. It has been established that, at an atmospheric temperature of 72° F., the body temperature of the cows rose to 103·5° F. and the rate of respiration to 79 per minute. These figures are abnormally high, especially when one considers that the normal temperature of a cow is approximately 101-101·5° F. and the normal rate of respiration 18 per minute.

Summer heat also adversely affects milk production. Controlled experiments in California and Missouri, U.S.A., have shown that a rise in the atmospheric temperature from 40° F. to 95° F., reduced the milk production of the cows concerned from 29 lb. to 17 lb. per day. The rations in these experiments were the same in all cases.

The effect of hot weather on dairy cows is influenced by quite a number of factors, and these factors may again influence one another. In practice these factors may be placed in two groups: First, there is the direct effect of heat on the cow as already indicated by the figures quoted above. Secondlly, the cows will graze considerably less. They are more inclined to look for shade on hot than on cooler days. It has been established that cows graze as much as 50 per cent. more on cooler than on hot days, and that during nights following on hot days they grazed more than on nights following on cooler days.

The effect of heat on individual cows varies; consequently, one would expect considerable differences in this respect. American research workers even maintain that heat tolerance is a hereditary character and that there are families within a breed more inured to heat than others. It is also universally accepted that the dairy breeds differ greatly in regard to the reaction to heat.

The second important factor which plays an important rôle in milk production, especially during hot weather, is the nature of the grazing. This factor is, of course, very closely associated with heat. It is difficult to distinguish between the effect of heat and that of poor grazing on milk production. Nevertheless, the farmer can attempt to neutralize these factors as far as possible or to adapt them to the advantage of his herd. One of the most important measures in this connection is to provide adequate green, succulent grazing during the very hot days. Beyond a doubt, good grazing is the corner stone of sound and progressive cattle farming.

If, however, grazing is poor or not available, the farmer must necessarily fall back on silage. It must, however, be remembered that silage can never take the place of grazing. Silage can only serve to supply the necessary succulence in the ration. One can imagine that a succulent feed would mean as much to cows on a hot day as a delicious cold drink to human beings. Cow's milk contains about 87 per cent. water. Cows with a high milk production therefore require a large quantity of water daily. It is desirable that cows take in at least a portion of this moisture in the form of succulent feed.

Since grazing plays such an important rôle in milk production, it is necessary for the farmer to direct every effort at making the best use

of all available grazing, especially in the struggle with the heat. To be successful, he should follow a sound grazing programme. He can, for example, see to it that his cows run on the best grazing during the day, so that they can eat their fill before the heat of the day. During the night they graze more comfortably and, if they run on poorer grazing then they can make much better use of it. If possible, the farmer should so arrange his grazing programme that the cows are near the byre at milking time. This precludes unnecessary walking in the heat. The object is to save any unnecessary expenditure of energy during hot days. This energy, in this case heat-energy, is derived from the feed. The more energy the cows waste in this way, the less capable they are of utilizing the feed for milk production. Unfortunately, a cow lacks the ordinary sweat glands of a human being; consequently she cannot so readily keep her temperature constant. Instead she becomes relatively hotter than a human being when the temperature rises.

Other useful measures for controlling the effect of heat on cows are the provision of adequate shade and of plenty of clean, fresh water. If possible, the shade and water should be within easy reach of the grazing on which the cows run. The shade provided should be airy. It is sometimes very close under a roof through lack of ventilation. Trees answer very well to this purpose, provided that they are leafy. Since the air moves freely under a tree, it is seldom close there.

Composure and tranquillity contribute much towards preventing unnecessary generation of heat. The farmer can do much in the way of keeping his cows calm and tranquil, and in this connection a good milking-shed routine is of paramount importance. Punctuality is the keynote of such a routine. A cow soon accustoms herself to her particular stall and to a good shed routine. If this routine is effective, the cows will spend a minimum of time in the waiting pen and in the cow stall. This good practice promotes transquillity and reduces the generation of heat to a large degree. Excitement and commotion during milking and when the cows are driven from the shed, are both unnecessary and undesirable. Here, too, it is a case of more haste, less speed—and also of less money.

Additional attention to cows during hot weather is well worth while. The work may seem superficial, sometimes unimportant, and yet the practice has ensured to the farmer a healthier dairy herd and an improved income.

Agro-Economic Survey of the Union.

The first report on the Agro-Economic Survey of the Union is now available as Bulletin No. 270 (Economic Series No. 34). Price 1s. per copy.

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Report No. 1 (Bulletin No. 270) is obtainable from the Editor Department of Agriculture, Pretoria, at 1s. per copy, post free.

The Pennisetum Grasses.

P. J. S. Coetzee, Botanist, College of Agriculture, Cedara.

THE genus Pennisetum is a fairly large one. There are approximately 120 to 130 species, the majority of which are found in the warmer regions of the world. In South Africa approximately seven species are found.

A prominent characteristic of the genus is the numerous bristles which are attached to the seed. As a rule the Pennisetum grasses are somewhat coarse, perennial in habit and very vigorous growers during the warm months. Generally the grasses belonging to this genus do not set much fertile seed, except in the case of Pearl Millet, which is an outstanding exception.

The finest types of Pennisetums are found in Africa. It can also be said that some of the most valuable fodder plants in South Africa belong to this genus. The following are the best known types:—

Elephant Grass.

Elephant grass *Pennisetum purpureum* Schum is one of the dominant grasses in the high grass savannas of Central Africa. Different varieties

Elephant Grass.

of this grass are cultivated under the names of Napier grass, Umfufu, etc. In Rhodesia it is termed Napier fodder after Colonel Napier, who first brought this grass into cultivation in Rhodesia.

Elephant grass is a somewhat coarse, reed-like grass. In South Africa it grows to an average height of approximately 8 to 10 ft.; but in rich marsh land in Kenya it has been observed to grow up to 21 ft. in height. It usually grows in tussocks, and sometimes stools considerably. When fully grown the leaves may reach a length of 2 ft., resembling those of maize. In mature plants the leaves are as a rule coarse, but in young plants and in the growth that follows grazing or cutting the leaves are soft and succulent.

The grass is known to grow fairly well on practically most types of soils, but it does best on alluvial or good sandy loams. A plot of Napier fodder established in December 1930 at the Cedara College of Agriculture on fairly poor soil has grown very well. The response to fertilizer was very good; the yield being approximately 30 tons of green fodder per half morgen.

Farmers generally regard this grass as moderately drought resistant. It is, nevertheless, a moisture loving grass, which grows with remarkable rapidity during hot weather if sufficient moisture is present. It has been observed to grow over 18 inches a week under optimum conditions.

Light frosts will not seriously affect the growth, but continuous heavy frost will kill the above-ground parts entirely.

The chemical compositions, obtained by the chemistery section at Cedara from plot material, are given in Table I.

TABLE I.—*Analysis of* Pennisetum purpureum (*Umfufu*) *showing differences in composition when cut at different stages of growth.*

Date of Cutting.	Length.	Crude Protein.	Crude Fibre.	Crude Fat.	Total Ash.	Soluble Carbs.	Total.	soluble Ash.	Lime (CaO).	Phosphoric Oxide.
		%	%	%	%	%	%	%	%	%
2/6/33	6–9 ft.	9·9	37·6	1·8	6·9	43·8	100	4·4	0·63	0·35
6/12/33	30-36 in.	19·2	33·0	1·9	9·9	36·0	100	5·9	0·74	0·45
9/1/34	3–4 ft.	15·6	36·0	1·6	9·6	37·2	100	5·2	0·56	0·39
22/2/34	24-36 in.	17·7	33·1	1·8	12·2	35·2	100	7·0	0·46	0·39
18/4/34	30-36 in.	18·1	30·0	2·5	14·4	35·0	100	7·0	0·43	0·58

Propagation.—It is possible to raise Elephant grass by means of seed; but in actual practice it has been found to be easier to propagate from slips or from rooted cuttings. The former can be planted in spring or autumn and the latter in spring only.

Cutting should be taken from fairly hard portions, preferably with three nodes. While rooted slips will take easily at any time during warm weather, cuttings should be allowed at least a couple of months to root themselves in, and should be planted approximately 18 inches apart in the row, with rows 3-5 feet apart. Slips may be cut three nodes in length and inserted to the same spacing, two nodes below and one above ground. They may be laid end to end in shallow furrows and covered with a couple of inches of soil in the same way as sugar cane.

It has been found that Elephant grass responds well to fertilizer. The following fertilizer mixture is recommended: Superphosphate, sulphate of ammonia, and muriate of potash in the proportion of 6 : 3 : 1 by weight applied at the rate of approximately 700 lb. per morgen in spring. Occasional applications of sulphate of ammonia at the rate of 200 lb. per morgen during the summer will serve to push on growth when required.

The palatability of the grass depends largely on the stage of growth at which it is utilized. It should not be allowed to grow taller than 4 ft.; as it then develops woodiness and becomes unpalatable. It can be used either as a fodder or as a pasture grass.

The Gold Coast Strain is recommended.

Kikuyu.

Kikuyu, *Pennisetum clandestinum,* Hochst, is indigenous to East Africa where it received its common name from the Kikuyu native tribe.

The grass is a creeping perennial having both above and underground runners. The underground runners produce roots at the nodes and send up vertical shoots. Kikuyu is a very vigorous grower during the summer months. It produces an abundance of fodder under suitable conditions and is especially valuable for grazing, as it withstands trampling by stock very well. Although it is adapted to warm climates it will nevertheless do well in relatively cold localities where during winter the above-ground parts will be killed by frost. The root system, however, is not injured by frost, and Kikuyu will usually come away earlier in the spring than most other summer-pasture grasses. It has proved to be fairly drought resistant; indications, however, point to the fact that a minimum rainfall of at least 30 inches is required to grow it successfully.

Kikuyu naturally responds best to good soils and can only be recommended for propagation where a fertile soil is available, preferably one that is rich in humus. Observations made on plot experiments supports this view and it would appear that most of the value of artificial fertilizers is likely to be lost in the case of Kikuyu if applied on solid soils deficient in humus.

Propagation.—Kikuyu strikes readily from rooted cuttings. The joints of the underground rhizomes are approximately 3 inches apart, and sections containing two-rooted joints are sufficient for planting.

Establishment can take place at any time during the warmer months when moisture conditions are suitable. About 12—15 bags of roots will be required to establish half a morgen.

Owing to the vigorous growth of the undergruond rhizomes, it is preferable that Kikuyu should not be planted on land that will soon be required for cultivation or on ground adjoining cultivated lands.

The nutritive quality of the grass is very satisfactory.

Numerous samples of Kikuyu have been analysed by the chemistry section at Cedara, and the results of a few of these analyses are given in Table II, in order to indicate the differences between leaf and stem and between young, vigorously growing grass and more mature herbage. A sample of old withered grass is also included to indicate the deterioration which sets in. For the sake of comparison the analysis of a *Paspalum dilatatum* sample is also given.

TABLE II.—*Percentage composition of* Pennisetum clandestinum, *showing differences in composition between young and more mature grass.*

	Young Kikuyu.	Kikuyu 12″–20″ long.		Old Kikuyu.	Paspalum 18″–24″ long.	
		Leaf.	Stem.		Leaf.	Stem.
Crude protein...	24·5	13·8	11·6	5·2	13·3	8·8
Crude fibre.....	20·0	30·5	33·9	31·7	36·2	43·2
Total ash......	10·2	7·6	7·6	7·1	6·9	6·4
Soluble ash.....	8·9	6·2	6·1	3·6	5·2	5·3
Lime..........	0·40	0·60	0·48	0·72	0·66	0·32
Phosphoric oxide	1·00	0·45	0·44	0·21	0·39	0·37

There seems to be little doubt that Kikuyu is one of our most valuable summer-pasture grasses when planted on suitable soils.

There is also no danger of prussic acid poisoning from Kikuyu. Steyn (1934) examined fresh specimens as well as specimens in all stages of wilting up to complete withering for the presence of prussic acid with negative results.

The Millet Grasses.

Of this variety of grasses, the *Pennisetum typhoides* (Burm.) Staff, and Hubbard (also known as *P. glaucum* R, Br.). commonly known as Pearl or Bulrush Millet, Kaffirmanna, " mbabala " or " nyoute ", is grown extensively (for grain) by natives in poor soils with a rainfull up to 25 inches, e.g., in Northern Zululand, Sekekuniland and Pietersburg (Curson, 1940).

Blou Buffels Grass.

The *Pennisetum cenchroides* has a very wide distribution, being found through the whole of Africa, Sicily and North-west India. Blou Buffels grass is somewhat coarse. It is well adapted, however, to withstand dry conditions and is probably more drought resistant than any of the other Pennisetums mentioned in this article.

Opinions as regards its palatability in the green state vary, but most farmers agree that it makes a fairly good hay if cut at the right stage.

Pennisetum cenchroides can be propagated vegetatively, and seed is not commercially procurable.

Natal Grass.

This grass, *Pennisetum unisetum. Bth.* (*renamed Beckeropsis uniseta K.* Schum.) grows naturally throughout almost the whole of Natal. Most farmers regard it as rather coarse and unpalatable. It is reasonably frost resistant and will yield approximately 4-5 tons of hay per half morgen.

A variety of this grass has been brought into cultivation under the name of " Silky Grass " by an Orange Free State farmer, who claims " that it will out-yield—without irrigation—such crops as lucerne and teff. It is also claimed that cattle prefer it to cut-up green mealie stalks, and that it will grow on poor as well as on rich soils ". It remains to be seen, however, whether these claims would be realised when the grass is established on a field scale.

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The Papaw and its Cultivation:—

[*Continued from page* 794.

For some years it has been noticed that farmers sow large quantities of seed and yet are unable to plant extensively. If, however, the necessary attention is given to the little hints in this article, the farmer should detect a considerable change to his advantage.

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Powdery Mildew or "White Rust" on Cucurbits.

J. J. du Toit, Plant Pathologist, Stellenbosch-Elsenburg Agricultural College, Stellenbosch.

THE first indication of the presence of this disease is a small, white, powdery blotch on either the lower or upper surface of an infected leaf. If these blotches occur first on the under side of the leaf, then light yellowish-green spots develop on the upper surface immediately opposite the blotch. As the disease progresses the plant becomes covered with a white, powdery fungous growth, it turns yellow, dries out and ultimately dies off.

The disease is caused by a fungus of the powdery mildew group. It is responsible for considerable annual losses to curcubit crops in the western and south-western Cape Province. Warm weather conditions such as usually prevail during November to January is particularly favourable for its development, especially when associated with moist air conditions. It must, however, be pointed out that this disease is not dependent on dew, and the absence of dew is no guarantee that the disease will not develop.

This disease is, contrary to so many other plant diseases, rather easily controlled—a fact which must be ascribed to the external existence of the causal fungus. It grows on the outer surface of the plant and can therefore be easily reached with a fungicide. The fungus is furthermore very sensitive to sulphur.

Effectiveness of Sulphur.

Experiments carried out during three successive seasons, clearly indicate that sulphur is much more effective against the powdery mildew fungus than copper-containing fungicides, such as copperoxychloride and bordeaux mixture. In fact, sulphur is so effective that it is unnecessary to commence with dusting before the first appearance of the disease.

The following case which occurred during 1947 clearly illustrated the effectiveness of sulphur. The author's attention was drawn to a land planted with little gem squashes, on which all the plants were already turning yellow as a result of a very heavy mildew infection. Half of these squashes were then thoroughly dusted with sulphur, while the other half was left untreated. The plants in the first half were again dusted at intervals of eight and fourteen days respectively, at which time nearly all of the untreated plants had died off, whereas the treated plants showed beautiful signs of recovery and ultimately actually yielded quite a reasonable crop.

Effect of sulphur on plants.—In the experiments on the control of powdery mildew, sulphur was applied to cucumbers, muskmelons, squashes, boer-pumpkins and watermelons. Of these, cucumbers and muskmelons were found to be so sensitive to sulphur, that they could easily be killed by a heavy sulphur dressing. Little gem squashes are moderately resistant, but will certainly suffer when sulphur is heavily applied. The plant's blossoms are particularly sensitive to sulphur burn. Watermelon and boer-pumpkin were found to be the most resistant, and damage will not so easily occur in their case, although the possibility is not altogether excluded. Sulphur must therefore under no circumstances be applied indifferently on these plants. It is imperative that only a minimum of sulphur should be applied with every application.

Method of Dusting.

In order to ensure that a very thorough coverage of each plant is obtained with the least amount of sulphur, it is first of all necessary to use a dusting machine with a very fine adjustment. The "sulphur bag method" of dusting must be strongly discouraged. In the second place, all the shoots of each plant must be arranged so as to run parallel with the main direction of each row. In doing this, habhazard growth which covers the whole land can be prevented and each row can be kept in form. The advantage of this practice is that dusting is very much facilitated. On such fields the labourer need not cope with individual shoots of plants, but with a fixed unit in a neat row. This also ensures a considerable saving in time and in sulphur consumption. A further advantage of this practice to lead the shoots, is that a dense growth is obtained which protect the fruits from sun scorch, an advantage which is of particular value in the case of honey dew melons.

The correct method of dusting really needs no special skill in this case. The dust-flow from the machine should be adjusted very finely and the dust-pipe held at a small distance from the plants, so that a fine floating cloud of dust can be blown in between the leaves at each blow. The amount of sulphur and the thickness of coverage can also be regulated to a considerable degree by increasing or decreasing the speed of pumping or walking.

The control programme recommended is as follows:—

(1) The first dusting to commence as soon as the first symptoms of the disease appear. It should be remembered that this can only be achieved by adopting the golden rule in connection with the control of most plant pests and diseases, viz., "regular visits and inspections of crops ensures the best guide to successful control."

(2) Dust again after 8 days.

(3) Dust 2 weeks after second dusting.

(4) Dust 2 to 3 weeks after third dusting.

(5) Dust again 3 weeks later, but only when the disease is still prevalent and danger of further development exists.

Summer Treatment of Vines:—

[*Continued from page* 801.

When ringbarked, young shoots should be fastened, otherwise they will be prone to break off at the wound. Ringbarking in currants is a common practice, the object being to enable the bunches to stick to the shoot more firmly, but more especially to prevent non-setting. This practice is applied when the blossoms start unfolding. It is advisable to protect the wound and this may easily be done by wrapping a vine leaf around it. Ringbarking is sometimes applied to table grapes, in which case it is done when the berries have more or less reached the size of peas. The object of ringbarking is to obtain larger berries and also to ensure earlier ripening. By ringbarking vines at this stage, grapes can be induced to ripen from 10 to 14 days earlier. In some species of grapes such as sultanas, etc. the berries are considerably larger when ringbarking is carried out at the correct time.

The Dropping of Immature Figs.

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Stellenbosch.

COMMERCIAL fig-growers and home-gardeners are often concerned about the failure of their trees to set or mature their fruit. To explain the reasons for this behaviour it is in the first instance necessary to consider the various types of figs which are generally grown.

Groups of Fig Types.

The various fig varieties my be classified under the following groups:—

Group I.—Those varieties which require pollination, or caprification as it is termed in the case of the fig, and which will not bear any ripe fruit unless provision is made to bring this about. The most important varieties belonging to this group are the *Smyrna* and *Calimyrna*.

Group II.—The first crop of this group, which is known as the *San Pedro* type, will usually set and mature, but the second and main

FIG. 1—A Kadota fig-tree planted in 1941 and photographed in Nov. 1948

crop will drop unless caprified. The only local variety in this group is the *Castle Kennedy*.

Group III.—This group contains the *Capri* types, an inedible variety which produces, however, the pollen with which the figs of groups I and II are fertilized. They are, therefore, of economic importance. There are three different types of these figs, usually known as Capri Nos. 1, 2 and 3. The fruit of these types ripen at different times of the year, thus affording the little wasp, *Blastophaga psenes*, a natural habitat in which to complete its life-cycle.

Group IV.—This group includes the common types of figs which do not require caprification. Most of our varieties, like *White Genoa, White*

FIG. 2—A Calimyrna fig-tree planted in 1940 and photographed in Nov. 1948.

Adriatic, Cape White, New Brunswick, Kadota and *Adams*, belong to this group.

Caprification.

By caprification is meant the carrying of the pollen from the male or *Capri* figs by the fig wasp *Blastophaga psenes* to the female flowers of figs of groups I and II mentioned above. If this process is not brought

 [*Continued on page* 822.

The Production and Uses of Sunn-Hemp.

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SUNN-HEMP (*Crotalaria juncea*) is a tall annual summer legume which is grown mainly for green-manuring purposes. It succeeds well in most parts of the summer-rainfall area and can be strongly recommended as a useful soil-renovator. It has several advantages over other green-manuring crops and should receive more attention at the present time, when manures and artificial fertilizers are scarce and expensive. Its main uses and characteristics can be briefly summarized as follows: —

The crop grows erect, so that it can be cut easily by means of a mower for hay or silage purposes. It is also ploughed under for green manure more easily than the trailing types of legumes generally grown.

In the early stages its rate of growth is rapid. The plants attain a height of three to four feet within six to eight weeks, and finally reach a height of five to eight feet within 3 to 3½ months. On account of its rapid growth, it is possible to obtain a fair crop of hay or green manure, even when sown late in the season.

Owing to its close planting and rapid and tall growth, it is an excellent crop to smother most kinds of weeds. Moreover, since the crop is generally sown broadcast, it requires no subsequent cultivation and further attention until harvesting time. The best results are obtained on well-prepared, clean lands.

Hardy Crop.

The crop withstands drought to a marked degree, while it also succeeds well under wet conditions, provided the soil does not actually become waterlogged.

In comparison with other legumes it is relatively free from pests and diseases. Its high resistance to eelworm or rootknot disease makes it one of the most useful legumes in rotation with tobacco, potatoes and other crops susceptible to this pest.

It produces an abundance of nitrogenous nodules on its roots and has a beneficial effect on the fertility of soils, even when cut for hay or ensilage. In the case of poor soils under irrigation and the absence of manures, it is definitely a most useful green-manuring crop for winter cereals. Wheat farmers in many areas have obtained excellent results with wheat when a summer crop of sunn-hemp had been ploughed in for green manure.

The feeding value of sunn-hemp hay compares fairly favourably with that of cowpeas and lucerne.

Formerly it was thought or maintained that the hay was not palatable to animals. Experiments conducted in Rhodesia and elsewhere have shown, however, that when cut in *the early bud or the flowering stage* and properly cured, the hay is not only fairly palatable to the animals, but is almost as valuable a feed as cowpea hay, while the yield of hay, under certain conditions, is higher than that from cowpeas. Experiments with pigs and cattle have also shown that there is no danger of poisoning, as occurs in the case of certain other crotalaria species. In the case of sheep and horses, however, the hay seems to be harmful to the health of the animals.

Another use of the crop that can be mentioned here is fibre-production. In India it is extensively grown for this purpose, and

although the fibre is not as suitable for the manufacture of canvas as that of true hemp, it is used extensively for making cordage. In that country average yields of 600 lb. clean fibre are obtainable per acre, but in this country sunn-hemp fibre has so far not been produced commercially. In Rhodesia yields of 300 to 400 lb. per acre have been obtained in experiments.

Citrus and other fruit farmers find sunn-hemp a good cover crop in orchards. Later the crop is easily ploughed under for green manure, because of its upright habit of growth.

Climatic, Soil and Fertilizer Requirements.

Sunn-hemp prefers a warm climate, but generally also succeeds fairly well in the cooler highveld area, if grown for green-manuring purposes. If seed is to be produced for own use, the crop should be sown early on the highveld, as it requires a frost-free period of about five months to produce seed. Since the crop is usually a shy seeder under highveld conditions, it will be best to leave seed production in the hands of farmers in the low or middleveld areas.

As previously stated, the crop is highly drought-resistant and will succeed well under dryland conditions in most areas receiving 20 or more inches of rain per annum.

Any type of soil which is not waterlogged or very infertile is suitable, though it will, of course, make its best growth on the richer soils, particularly on fertile loam soils. When grown as a fibre crop it requires a light and not necessarily very rich soil. If grown on too rich soils, the quality of the fibre deteriorates. In general it can be stated that preference should be given to light soils rather than heavy clay soils.

Like most other crops, sunn-hemp responds well to applications of 200 to 400 lb. superphosphate per morgen. When grown under dryland conditions in rotation with maize or other crops, the fertilizer can be applied to the preceding crop and none to the sunn-hemp, The latter will benefit from the residual effect of the fertilizer applied to the previous crop in the rotation.

When grown for green-manuring purposes on irrigable lands, it is best to apply the fertilizer to the sunn-hemp, rather than to the succeeding crop, since a greater bulk of green material is then obtained, and when this is ploughed under, the phosphates are mobilized largely in organic form for the succeeding crop.

Time of Sowing.

The crop can be sown any time from October until December or the beginning of January, whenever moisture conditions are favourable. If grown for green manure, it should be sown as early as possible so that it will reach the proper stage for ploughing under early in autumn. This will allow the incorporated material at least five or six weeks to decompose before the winter crop is sown.

The seed is sown broadcast on a well-prepared fine seed-bed at the rate of about 60 lb. to 70 lb. per morgen for green manuring purposes. If a seed drill should be available, seed can be economized; that is, only about 40 lb. to 50 lb. instead of 70 lb. will be necessary per morgen. After broadcasting the seed, it should be worked into the soil, preferably by means of a disc-harrow. A spike-tooth harrow generally does not cover all the seed sufficiently. The seed should be covered to a depth of about 1½ inches to 2 inches.

When grown for seed, the crop is best drilled in rows 20 inches to 21 inches apart, in which case about 30 lb. to 40 lb. seed will be required per morgen. A maize planter fitted with kaffircorn plates

can be used for planting the rows 42 inches apart, and these rows are then straddled by going over the land a second time.

If the crop is to be grown for fibre production, the seed should be broadcast thickly, that is, at the rate of about 150 lb. per morgen, so that straight unbranched plants will be obtained.

Harvesting.

When it is proposed to harvest for seed it is customary to top the plants when they are about 2½ ft. high. This induces branching and the formation of a greater number of flowers, thus increasing the yield per morgen.

When the majority of pods are turning yellow and the seeds rattle in the pods, the crop is cut, tied into bundles and stooked in the field. In these stooks the plants are allowed to dry out completely for about two weeks. They are then carted to a suitable threshing floor and the seed is threshed by beating small bundles against a hard object, by trampling with animals, or by means of a wheat threshing machine suitably adjusted. An average yield of seed is about four to eight bags (203 lb. each) per morgen.

When cutting the crop for seed, as long a stubble as possible must be left, as this, when ploughed under, will materially benefit the soil, while the short tops will pass more readily through a wheat thresher.

Hay, Silage or Green Manure.

Sunn-hemp is indeterminate in growth, that is, the flowers are not all produced at the same time, so that by the time the first pods are well formed and beginning to ripen, the upper portions of the branches on the same plant might still be in the flowering stage. When left to mature beyond the late-flowering stage, however, the plants become very fibrous or woody and the feeding value decreases. It has been demonstrated that the best time to plough sunn-hemp under for green manure is when the plants are in full flower and the first pods well formed but still in a green state.

For hay or silage purposes the crop can be cut even at an earlier stage, that is, in the budding stage, just before the crop comes into flower. At this stage the feeding value is the highest and the hay obtained also more palatable to animals. The total yield of hay will, however, be appreciably less, so that the full flowering stage will be a more suitable average stage.

For hay, the plants, after being cut with a mower, are left to wilt for about a day in the swath, then raked into windrows and after about two days worked into small cocks by means of hay forks. In these cocks the material should be allowed to cure and dry out completely for about five to seven days, depending on weather conditions. If the stems should still be moist when placed in a big stack, there will be danger that the material will ferment and become mouldy. On the other hand, the drying process should not be delayed too long, as loss of leaves and bleaching in the sun will be excessive.

The stack is made in the same manner as in the case of cowpeas or other hay crops. The top should be given a dome shape and if possible capped with a layer of teff or grass so as to facilitate the shedding of rain water.

As in the case of most other legumes, wastage of valuable food material generally occurs if the crop is stored in the form of hay, due to loss of leaves and bleaching by the sun, or damage by excessive rains after the crop is cut. These losses can be reduced considerably by ensiling the green material directly after cutting the crop (at the

same stage of growth as for hay). If the material is to be ensiled alone, then about three gallons of molasses, diluted with five or six gallons of water, should be applied systematically to every ton of sunn-hemp. If some green maize or ambercane is available, these can be thoroughly mixed with the sunn-hemp in the ratio of two or three parts of the former to one part of the latter, and in this case the addition of molasses is unnecessary.

As a warning it can be stated that sunn-hemp in an advanced stage of growth is generally so fibrous that the material cannot be cut successfully by means of a power-driven silage cutter, as the tough fibres tend to clog or jam the cutter. Young plants in the budding or early-flowering stage will, however, not cause any trouble. Older plants should be ensiled whole.

About three to six or more tons of hay can be obtained per morgen, depending on the soil fertility and moisture conditions. Up to 30 or more tons of green material can be obtained per morgen under favourable conditions for silage or green-manuring purposes.

Green Manure.

Since the crop is upright in habit of growth it can be ploughed under fairly easily by means of a mould-board plough. If double-furrow ploughs are used they should have a good clearance. It is also claimed that if a heavy chain is adjusted to drag just in front of every turning furrow slice, the tall plants will be drawn straight into the furrow and thus completely covered.

The crop is best ploughed under when in the late flowering and full green-pod stage, but can also be ploughed under sooner, depending on the following important factor, namely the moisture condition of the soil. A green-manure crop should not be ploughed under if the soil is dry, as moisture is essential for the activities of the micro-organisms that decompose green plant material and change it to nitrates and humus in the soil. It is therefore important to plough under the crop after a soaking rain or an irrigation even though the crop might not have reached the specific stage of growth mentioned above.

If the soil is moist when the crop is ploughed under and is not left in too loose a condition, the mass of vegetation will be rotted down in about 5 to 6 weeks. The succeeding crop should therefore not be sown sooner than this period after the sunn-hemp has been ploughed in.

Sunn-hemp is not a well-known crop in many parts of the summer rainfall area. In view of its good qualities and general suitability for green-manuring purposes, it will no doubt play a bigger role in agriculture in future.

The Dropping of Immature Figs:—

[*Continued from page* 818.

about, the second crop of the *Castle Kennedy* and both crops of the *Calimyrna* and *Smyrna* varieties will not be fertilized and will consequently drop before becoming edible.

To give the fig wasp a chance to complete its life-cycle, it is essential to grow *Capri* figs Nos. 1, 2 and 3. When once these trees start bearing, measures should be taken to establish the wasp in these wild figs. To bring about caprification, *Capri* figs which harbour the wasp are hung up in small wire baskets once or twice during the season in those trees which have to be caprified.

[*Continued on page* 830.

Hygiene on the Turkey Farm.

J. D. W. A. Coles, Research Officer, Onderstepoort.

TURKEY breeders should refer to the article on hygiene on the poultry farm in the June 1948 issue of *Farming in South Africa,* because the information contained therein applies with equal force to both turkeys and fowls in regard to a pure water supply, contamination of the soil, sterilization of feed sacks and incubators and crates, vaccination against fowl-pox and fowl typhoid, and the B.W.D. test.

Certain points, however, need special emphasis and these will be discussed at some length in this article.

As in the case of all other poultry, no farmer should introduce adult turkeys on to his farm, because, although they may look well they may be harbouring the causal organism of roup, cholera, fowl typhoid, B.W.D., blackhead, hexamitiasis and other diseases. If new blood must be obtained, it should be introduced only in the form of fertile eggs or day-old poults emanating from premises officially certified to be free of B.W.D. reactors.

It is not advisable to keep pigeons with turkeys, because the former can transmit the deadly diseases paratyphoid and trichomoniasis to the latter.

It is best not to mix fowls and turkeys, for the small caecal worms of the hen act very well as carriers of the germs of blackhead from one fowl or turkey to another.

If a farmer is interested in turkeys, it is far better for him to keep no other poultry or pigeons. If he must keep fowls or ducks, he should ensure that the turkeys are isolated from the other birds as much as possible.

Rearing of Turkeys.

Turkey eggs should be hatched in incubators, and never under turkeys or fowls. The poults are brooded exactly like chickens, but 15 square inches of floor space is allowed for each under the hover. One square foot of the total floor space is necessary for each poult put into the brooder house. Do not run more than 300 poults in one group. Keep the poults in the brooder house and camp for 8 weeks, and do not allow them out in wet or cold weather.

These first 8 weeks are most important. It is best to have one or two portable brooder houses of 10 ft. by 10 ft. and capable, therefore, of housing 100 poults. Each house should have a coal or oil-burning brooder. The house must be near the homestead and on a piece of ground that has not been occupied by any poultry for at least 18 months, and the fenced-off ground round the brooder house should be approximately 40 ft. by 40 ft. At least two lots of poults can be brooded in one camp during one season, but the brooder house should be moved on to clean ground the following year.

In fine weather the food and water receptacles should be just inside the fence, so that they can be filled without the necessity of an attendant entering the camp. In wet or very cold weather, and also during the first week of brooding, the receptacles are kept inside the brooder house. It is best that the farmer himself and nobody else should enter the camp or brooder house, and even then he should put on a pair of goloshes or special shoes at the gate. The possibility of hexamitiasis decimating the young poults is reason for this stringent precaution.

After the age of 8 or 9 weeks the poults are usually put out on range. Have three ranges, using one each year. This means that ground is completely rested for two years. Each range, preferably under lucern or kikuyu, is fenced off into dog-proof paddocks, which are also used in rotation, so that each is occupied for a week and then rested for three weeks. By doing this we overcome the danger of blackhead, and this is always a most important consideration.

If there are windbreaks consisting of belts of trees, the birds in the camps can sleep in the open on perches raised from 2 to 6 feet above the ground. If there is no protection against the elements, simple sheds facing between north and east may be provided. *Be most careful not to stampede turkeys at night.*

Separate the sexes when this becomes possible at about 16 weeks. Turkeys are marketed at the age of 6 to 7 months. If ground is scarce, they are taken from the brooders and raised in confinement in yards with cement floors until they are sold. A yard 100 ft. by 25 ft. in size is big enough for 100 birds. Naturally, all the feed required has to be carted to these yards. Plenty of shade in camps and yards is essential.

The best of the males and females are retained as potential breeders and are kept on range, and egg production begins at the age of 10 to 11 months, when the maximum body weight it attained.

If the tom's toe-nails are sharp, they must be trimmed to prevent injury to the back of the hen.

A breeding tom and his hens are usually put in a small camp on clean ground, preferably where plenty of lucern or grass is growing, about a month before eggs for hatching are to be collected. A small shelter is needed in such a camp. Breeding birds need not be kept entirely on cement floors unless the ground is very limited, or unless this step is advised by a veterinarian.

The Feeding of Turkeys.

A few words about feeding. The mash should not be too fine and powdery, because this may lead to the development of sore mouths. Turkeys occasionally refuse to eat or drink out of strange receptacles and, when transferring them from one camp or house to another, it may be necessary to take the known receptacles along and use them until the birds have grown accustomed to the new ones. When birds are to be moved from one place to another on the farm, transport them in the evening. It is very important to store all feed in mouse-proof bins and rooms. Also keep mice out of the brooder house, so that they cannot foul the mash in the hoppers. The reason for this is that mice, as well as pigeons, may be carriers of paratyphoid. Decomposing flesh or vegetable matter should not be fed to turkeys, owing to the risk of death from botulism (lamsiekte). Farmers should be warned against the potential danger of watering the ranging turkeys from furrows passing from camp to camp. Typhoid, for instance, would spread rapidly if such water became infected.

Chicken-pox vaccine should be used when the poults are one to three months old and the new kind of vaccine is the better. Fowl typhoid vaccine should be used, and the B.W.D. test carried out, just as in the case of fowls.

By reading the pamphlets on roup and fowl parasites, the turkey breeder will learn how to cope with these problems. In these. as in other respects, it is all-important never to mix turkeys hatched in different years, and not to put young birds in camps, houses and yards vacated less than a week before by older turkeys.

[*Continued on page* 828.

Planning a new Table-grape Vineyard.

M. S. le Roux, Western Province Fruit Research Station, Stellenbosch.

IN view of the uncertain economic conditions obtaining throughout the world to-day, it is essential that farmers should proceed carefully when planning a new vineyard. The vineyard laid out to-day will not be in full production for another three years or more. Due cognizance must be taken of the fact that it may be expected to remain in production for the remainder of the farmer's life, and also of the probability of a future drop in market prices. Specially thorough

FIG. I—Waltham Cross for years the peer among export grapes, is, since the post-war resumption of export, being eclipsed by Barlinka.

consideration is necessary with regard to the time of ripening, the requirements of the soil, espacement, trellising systems and varieties. A brief discussion of these factors is given below:—

Ripening Time.

Since the ripening time of grapes is largely predetermined by the geographical situation of the farm, it cannot be influenced much by human agency, except, of course, in the selection of appropriate varieties. Nevertheless, prospective purchasers of ground would do well to consider that the time of marketing varies greatly in the different regions. It is patent that if the present system of uniform seasonal prices for grapes were to fall away, the person who cannot market his grapes either during January to early February, or alternatively towards the end of April or later, will be at a disadvantage, as was the case before World War II. Since all our most important table-grape regions, supply the market during February and March, the

oversea and the relatively limited inland markets are often heavily supplied and even glutted during this period, and accordingly the prices drop. *The cultivation of table-grapes in the mid-season regions should therefore be considered only where the other conditions for production, such as, soil fertility, labour, etc., are particularly favourable.*

Soil and Moisture Requirements.

Table-grapes may be cultivated with a fair measure of success on a large variety of soil types varying from a good sand to light clay. A prerequisite, however, is *that the soil should be at least two to three feet deep.* Near the coast where the humidity is high and transpiration through the leaves therefore less, a vineyard naturally does considerably better on somewhat shallow soil than is the case in dry inland regions. Moisture is essential to attractiveness and a pleasant taste in grapes. It is true that on shallow soil the moisture requirements may sometimes be supplemented by irrigation, but where too much reliance is placed on irrigation, production is very expensive and, since such shallow soil soon becomes parched, it is virtually impossible to regulate irrigation in such a way as to ensure that the quality in general, and the keeping quality of the grapes will constantly suffer either as a result of too little or of excessive irrigation. True, as the writer has proved by excavations, approximately 75 per cent. of the vine roots are spread over the upper 18 inches layer of soil, but the importance of the number of smaller roots that penetrate deeper must not be underestimated, since they are essential to the provision of moisture during autumn. It is useless, therefore, to attempt to establish a table-grape vineyard on shallow soil a foot deep, however fertile the soil may be, for, irrespective of the quality of the subsoil, the roots should be able to penetrate at least a few feet deeper, in search of moisture. The depth of the soil is, however, not the only factor to be considered. Of equal importance in some inland areas is the provision of irrigation water *to supplement* the soil moisture. The farmer who is unable to irrigate, will find it difficult to compete with his fellow-farmer who is in a position to do so. Irrigation, if judiciously applied, will ensure very much larger crops of a higher quality, without impairing the keeping quality. Adequate moisture will ensure the safety of the crop on which so much money is spent. To venture to establish a vineyard, without making provision for an adequate supply of moisture is therefore inexpedient. In most parts of our vinegrowing area there should be sufficient water available for at least two or three thorough irrigations. These moisture requirements may perhaps create the impression that the quality of the soil is of little account provided that the soil is deep enough and that moisture is available. It is true that, if there is sufficient moisture and the necessary nutrients are supplied by fertilization, some varieties of table-grapes will also thrive fairly well on comparatively poor soil, but heavy fertilization raises production costs and, for economic production, the soil should be naturally fertile.

Espacement and Trellising Systems.

Such questions as correct trellising systems and suitable espacements should be considered in good time, since the success of an undertaking is closely bound up with these considerations, especially in the erection of trellises.

The trellising system most suitable for a specific piece of ground is contingent on a number of factors, the most important of which is the vigour of vines. This, in turn, depends on the fertility of the soil, the

varieties, the available moisture, etc. The determination of the most suitable system sometimes calls for considerable experience and judgment. Where conditions are very favourable, the overhead trellis is second to none. This type of trellis allows of the greatest leaf development, and since the leaves are the factories of the plant, this system furnishes the highest yields per unit of soil. The few disadvantages af the overhead trellis are more than offset by its obvious advantages, such as, larger crops, cheaper cultivation, better supervision over labour, etc. Farmers who have a knowledge of this type of trellis will readily concede this point.

A factor of paramount importance in the overhead trellis is a very wide espacement, since this will ensure an attractive colour in the grapes despite the heavier crops, and will also help to protect the grapes against fungus diseases, etc. The espacement should allow of easy penetration of sunlight. This is particularly necessary for the growth of green-manuring crops, since, if the penetration of sunlight is inadequate, lupins, "gousblom" and other plants will later be completely ousted by the less valuable sorrel. When erecting an overhead trellis, an espacement of 12 ft. by 12 ft. to 20 ft. by 20 ft. should be aimed at on the finest soils. Where a wide espacement is aimed at, it will probably pay to plant more densely at first and then gradually to remove certain vines.

Where conditions are not suited to an overhead trellis, a slanting trellis may be erected, if the wind-direction together with the topography allow of it. Such a trellis usually has a leaf canopy of from four to five feet in width resting on six or seven strands of wire. In this type of trellis the development of the vine is considerably smaller, but still considerably more extensive than in the common, though old-fashioned small three-strand Perold trellis. The espacement in the slanting trellis may vary from 9 ft. by 5 ft. for a narrow trellis, to about 10 ft. by 10 ft. for a wider one. Anything narrower than this can hardly be recommended for any type of trellis, especially if the demands of increasing mechanisation are taken into account. Tractors and spraying pumps save labour, but require moving space.

Choice of Varieties.

Of the two dozen or more table-grape varieties cultivated commercially in South Africa to-day, only a few were able successfully to stand the tests of time in regard to production, keeping quality and marketing requirements.

According to the latest data of the oversea representative of the Decidious Fruit Board for the 1947-48 crop, the varieties Barlinka (33 per cent.), Waltham Cross (28 per cent.) and Alphonse Lavallée (19 per cent.), still top the list for export (percentages in brackets) and are consolidating their position. Together they already furnish 80 per cent. of the Union's export grape crop. They are followed by Almeria (5·4 per cent.), Hanepoot (5·3 per cent.), New Cross (2 per cent.), etc. Barlinka, especially, has made a great advance on its pre-war position. This excellent late black grape now surpasses Waltham Cross and Alphonse Lavallée in production. It is pre-eminently suited to the inland grape regions, such as Hex River with its long, dry autumn. As against this, Waltham Cross (early, white), Alphonse Lavallée (early, black), and Hanepoot (mid-season, white or red) may be cultivated with fair success in all grape regions. Its predisposition towards non-setting makes Hanepoot more fastidious than the rest.

As regards the soil requirements of the different varieties, the most serious imperfection of Barlinka, viz., poor colour, is most noticeable in fertile-irrigated alluvial soils which are rich in humus. Waltham Cross,

again, is definitely not at home in poor sandy soil where Alphonse Lavallée will still thrive fairly well. In rich soil Waltham Cross, again, is rather more subject to millerandage or seedless berries. Alphonse Lavallée also thrives well in rich dark soil where it colours considerably better than Barlinka. Hanepoot does best in well-drained, fertile, dry, warm soil.

As with almost all table-grape varieties, the above varieties are also susceptible to Bacterial Blight. Possibly Alphonse and Hanepoot are slightly less susceptible, but Waltham Cross and Barlinka are undoubtedly very susceptible. Waltham Cross and Hanepoot are fairly subject to the fungus diseases—anthracnose and oidium (powdery mildew) respectively. Barlinka and Alphonse ordinarily give little trouble if the necessary standard precautionary measures are taken. Late varieties like Barlinka, are naturally subject to attacks by botrytis rot and the fruit fly.

Popular Varieties.

As regards keeping quality and popularity with the public, Barlinka can lay claim to outstanding keeping qualities and also has a pleasant flavour. Waltham Cross, too, can stand a great deal of handling and transport, but, under dry conditions, its stalks are inclined to dry and the berries are shed in transit. The flavour is satisfactory. Alphonse Lavallée is considerably softer than Waltham Cross but nevertheless quite suitable for transport over long distances, and especially its appearance makes it very popular with the public. Its delicious muscat flavour makes Hanepoot by far the most popular table-grape, at least on the local markets, but its poor transport quality is well-known. Almeria is unrivalled for keeping quality, but its flavour is not popular; moreover, it gives a most inconsistent crop and consequently cannot be recommended. New Cross bears more regularly but its flavour is not popular and it is subject to millerandage.

As regards other varieties, there is at this stage nothing new which can be recommended, on the basis of thorough tests as an improvement on our existing varieties. The importance of an improved complex of varieties is realized and this Institution continues in its efforts to improve the position by breeding, selection and importation, and it may confidently be expected that better varieties will become available from time to time.

Meanwhile farmers are strongly advised against rashness in planting new varieties on a large scale, as has so frequently happened in the past. Until the cultivation whims, transport, as well as the marketing qualities of the new varieties have been scientifically investigated for several seasons, it may prove a very costly experience for the grower to establish an untested variety.

Hygiene on the Turkey Farm:—

[*Continued from page* 824.

It is as well to end this article by referring to one or two fallacies. Turkeys are not hard to rear, if the precautions outlined above are observed, nor is dew dangerous, provided the poults are warm enough and are not being exposed to disease germs.

Overheating and Chilling of Chickens.

J. D. W. A. Coles, Veterinary Research Officer, Onderstepoort.

IF anybody were to ask what single cause is responsible for the greatest number of deaths among chickens, the answer would deal exclusively with the temperature of the brooder. Infectious diseases do wipe out chickens by the thousand, but incorrect temperatures are responsible for very many more deaths. The usual story is: " I put a magnificent lot of chicks in the brooder-house, and now they are dying like flies. Some have diarrhoea, while some just twist their necks, stagger and then die. I'm sure it must be bacillary white diarrhoea." The cause is a far simpler thing than bacillary white diarrhoea, and the following description reveals the essential details.

Symptoms.

Overheating.—The chicks get as far away as possible from the source of heat, but later may even approach it. The wings are outspread. The chicks gasp, sweat and have an offensive odour. Some get diarrhoea, and die; others get spasms of various muscles, and twist their necks, etc. Deaths may occur at any time within about a month after the exposure to excessive heat, though most deaths take place within three or four days. Survivors have their growth checked, and the adult flock is weakly and uneven in size.

Chilling.—The chicks huddle so close together that those in the middle of the clump, or those that get pushed into the corner, are crushed to death. Those that are alive in the morning look mopy, and soon develop diarrhoea. Death may occur in anything up to about a fortnight, though here again most succumb during the first few days. Survivors grow unevenly, and never make a flock that the owner can be proud of. They usually develop into culls.

Diseases Mistakable for these Conditions.

Other diseases which can be mistaken for these condition are the following: —

Bacillary White Diarrhoea.—If the chicks start dying after the third day and deaths are numerous during the first fortnight, you are justified in suspecting bacillary white diarrhoea.

Bacillus aertrycke infection.—This is an infectious disease sometimes seen in chicks about one to three weeks old. The symptoms rather resemble those due to overheating, and a bacteriological examination of the blood is necessarry before it can be said definitely whether the disease is present or not.

Aspergillosis (*Brooder-house pneumonia*).—To-day, this is rarely seen. The disease usually attacks chicks in damp, musty brooder-houses, especially if the litter is at all mouldy. The causal mould will be found when material is examined microscopically.

Aegyptianellosis.—This is sometimes seen in chicks two to three weeks old. The chick is very mopy, and has a bright-green diarrhoea. The disease is due to a blood parasite transmitted by the tampan, and is very fatal.

Spirocheatosis.—This is occasionally seen in chicks over a week old. They are mopy and have a greenish diarrhoea. The blood parasite causing it is transmitted by the tampan. The disease is usually fatal.

All the obove-described diseases can be established definitely by an expert only.

Avoidance of Mortality due to Chilling and Overheating.

To avoid mortality due to chilling and overheating:—

Do not let the chicks out on a bright morning when the air is still chilly.

Do not expose chicks to draughts, but provide good ventilation. The temperature required by chicks under the hover during the first week is 90° to 95° F., during the second week, 85° to 90° F., and in the third week, 80° to 85° F., while in the fourth and fifth weeks it should not deviate more than a degree or two from 70° F. The temperature in the brooder-house during the first 6 or 7 weeks should not fall below 65° F.

Visit the chicks as often as possible during the day and night to see that they are comfortable and not crowding together or gasping for fresh air. Most chickens brooded in boxes in kitchens are chilled between 3 and 6 a.m., after the stove has gone out.

Turkeys are brooded under the same conditions.

The Dropping of Immature Figs:—

[*Continued from page* 822.

Home-gardeners are strongly advised not to plant any trees of groups I or II, as it is deemed unpractical to make provision for the caprification of only a few trees. This Institution does not undertake to supply any *Capri* figs harbouring the fig wasp to non-commercial growers. If, however, a farmer intends growing *Calimyrna* figs on a large scale further information and assistance will be given.

Dropping of Fruit of Group IV.

Often it is found that some varieties of the common fig are also inclined to drop their fruit. To determine the exact cause of this phenemenon is sometimes rather difficult. The following could, however, be mentioned, as being the most important factors:

Improper Cultivation and Irrigation.—The fig-tree having a shallow root-system, it is not advisable to cultivate or dig near the tree. The roots should be disturbed as little as possible. Irrigation should be applied frequently and thoroughly in order to keep the soil well-supplied with moisture.

If the dropping of fruit is to be avoided, the growth of the terminal leaves of vigorous trees should not be arrested. The tree itself very soon shows when water is required.

Lack of nitrogen.—If trees are not adequately fed, and especially if there is a marked lack of nitrogen, the setting of the fruit will be affected. If stable manure is used it should be given early and worked in shallowly.

Climatic considerations.—Young fig-trees are tender and susceptible to frost damage. In California commercial fig-culture on a large scale is limited to the hot interior valleys where the trees are exposed to an abundance of sunshine and are free from chilling winds directly from the ocean.

Pests and diseases.—If the trees are attacked by certain pests like red spider, but mite and root nematode or are suffering from virus diseases, the vitality of the tree is adversely affected, limiting in its turn the setting of fruit.

Does Feeding Influence the S.N.F. Content of Milk?

S. Bakalor, Dairy Section, Agricultural Research Institute, Pretoria.

THE solids-not-fat (S.N.F.) in milk is that important group of constituents which consists mainly of the proteins (such as casein), the ash (or mineral matter) and lactose (or milk sugar). The percentages of these constituents in milk greatly influence the yield of concentrated dairy products, such as condensed milk, milk powder and cheese, as well as the nutritive value of whole milk. As the average S.N.F. content of local milk has shown a decline over recent years and is at present unsatisfactory, it is obvious that a knowledge of the factors influencing the amount of S.N.F. in milk is of great economic and nutritional importance. Such factors are, for example, the influence of breeding, age of cow, stage of lactation and diseases, such as mastitis.

Variations in the S.N.F. content of milk of different breeds are similar to the better-known differences in fat content. The average S.N.F. and protein contents of Jersey milk are, for example, higher than those of Ayrshire milk, whereas the Ayrshire averages are again higher than those of Friesland milk. Differences in ability to yield milk testing high in S.N.F. may, of course, vary within a breed.

There is a progressive decline in the S.N.F. content of milk as the cow grows older. The S.N.F. tends to decrease, too, during the second to fourth months of lactation, but rises again towards the end of the lactation period. This latter rise does not occur in the case of barren cows, the milk which, indeed tends to decline in S.N.F. as lactation advances. Mastitis, too, reduces the casein and lactose contents of milk.

Effect of Feeding.

There is general agreement among research workers in regard to the influence of factors such as the above, on composition; but what, it may be asked, is the effect of feeding? Dairy farmers often state that feeding influences the S.N.F. content of milk. Many standard works on dairy chemistry, as well as official bulletins, have, up to the present, disagreed with this view.

In studies conducted at this Institute on the effect of climatic factors on composition, evidence has been found which indicates that nutrition must have some influence on the S.N.F. content. The monthly variations for the S.N.F. percentage of milk produced in districts in both the summer- and winter-rainfall areas, show that there is a drop in the S.N.F. content during the dry period of the year when veld grasses are fibrous and lacking in essential nutrients. The incidence of samples deficient in S.N.F. is also highest during this period. When the first good rains of the season bring about an improvement in the quality of grazing, an increase in the average S.N.F. content of supplies is found. In the Pretoria city milk production area, it has been shown that milk is low in both protein and lactose during the dry late winter and early spring.

As long ago as 1896, van Slyke, the eminent American dairy chemist, found that during a period of severe drought in New York State, which resulted in a certain amount of starvation of cows, there was a marked

decrease in the casein content of milk. This decrease lowered the yield of cheese manufactured from such milk appreciably.[3]

In 1932, Lesser, working in England, found that cows on pasture during the early summer months, May and June, secreted milk higher in S.N.F. and lactose, than in the preceding winter, when the mixed milk of the herd always fell below the standard of 8·5 per cent. S.N.F.[1]

The above, however, is largely circumstantial evidence. Concerned at the decline in the average S.N.F. content of milk in England, especially during the winter months of the war years, the National Institute for Research in Dairying, at Reading, conducted a controlled experiment during the winter and spring of 1944-45, to test the effect of known deficiencies of starch and protein equivalents on the composition of milk. In one trial a group of cows was fed, for some weeks, on a ration that was normal in its protein content, but which provided only 75 per cent. of the normal total energy (starch equivalent) requirements. In five weeks, the S.N.F. content of the milk of these cows fell from 8·68 to 8·34 per cent., whereas the corresponding fall in protein was from 3·07 to 2·86 per cent.

In another trial, the ration was normal for starch equivalent (total energy) but contained only 60 per cent. of the standard protein requirements. This treatment also caused a fall in S.N.F. and protein content of the milk, but it was less marked than in the first-mentioned trial. The S.N.F. dropped from 8·68 to 8·50 per cent., and the protein from 3·07 to 2·95 per cent. In the first trial, the S.N.F. and protein declined by 0·34 and 0·21 per cent. respectively, whereas in the last-mentioned trial the corresponding figures were 0·18 and 0·12 per cent. Deficiency in the carbohydrate content of rations would appear to have had a greater influence on the S.N.F. content of milk than a deficency in protein.[2]

These results from Reading stress the need, not only for the correct use of farm-grown feeds and purchased concentrates, but also for ensuring that farm-grown feeds and established pastures are of high nutritive value. At the above-mentioned institution, experiments with rations which differed only in the quality of the hay fed, showed that milk of lower S.N.F. content was produced on the poorer-quality hay.

The influence of deficiencies in the quality of feeding on the S.N.F. content of milk, has thus been clearly demonstrated, not only by our local studies, but also by these overseas experiments. In attempting to improve the S.N.F. content of local milk supplies, full consideration will therefore have to be given to the adequate feeding of stock, especially during the dry periods, when natural grazing is very poor.

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Control of Household Insects.